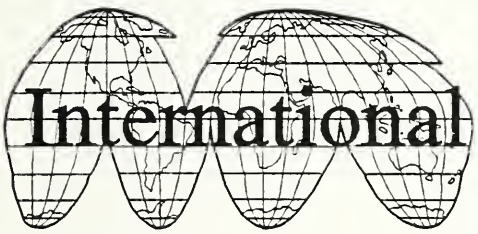
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International Fire Detection Bibliography 1975-1990

Richard W. Bukowski
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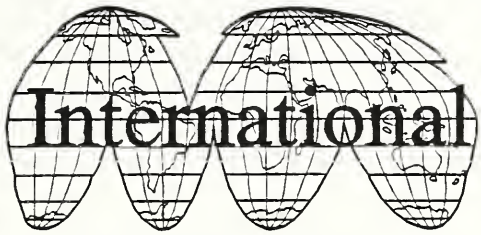
Building and Fire Research Laboratory
Gaithersburg, Maryland 20899

September 1991

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International Fire Detection Bibliography 1975-1990

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Nora H. Jason

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September 1991



U.S. DEPARTMENT OF COMMERCE, Robert A. Mosbacher, Secretary
NATIONAL INSTITUTE OF STANDARDS
AND TECHNOLOGY, John W. Lyons, Director

About the Project

This bibliography was assembled by the Building and Fire Research Laboratory (BFRL) of the National Institute of Standards and Technology (NIST) as the first phase of the National Fire Detection Research Project. This represents a long term research commitment by the National Fire Protection Research Foundation (NFPRF) in support of the Fire Detection Institute (FDI). By documenting the state-of-the-art it is hoped that a rational program of research in fire detection technology can be identified, and commentary to that end is included in this report.

This bibliography begins in 1975 because it was at that time that another comprehensive bibliography was published as the result of a project sponsored by the National Aeronautics and Space Administration (NASA). While primarily a technology review, this report titled *Fire Detection: The State-of-the-Art* by R.L.P. Custer and R. G. Bright (NBS Technical Note 839, available from the US Government Printing Office) contains 91 references and a thorough bibliography covering the earlier years of detection research and development.

The literature was collected from several sources. It began with FIREDOC - the BFRL Fire Research bibliographic database. Then a request was made to the members of InFIRE (International Network for Fire Information and Reference Exchange) for any further works not in FIREDOC. InFIRE is an organization of the world's public and private fire libraries operating under the auspices of the Society of Fire Protection Engineers (SFPE). Finally, personal letters were sent to many of the key researchers in the world asking for any other documents with which they might be familiar and which fit the selected search criteria. The result was a collection of nearly 1000 documents of which about 10% are in a language other than English.

The bibliographic citations include abstracts wherever they are not protected by copyright. Thus, these foreign language documents presented a problem not only from the titles, but also the abstracts. Thus, the project's Technical Advisory Committee (TAC) decided that translations of most of the titles and abstracts should be arranged so that persons interested in the work could better decide if translating the entire document was warranted. The limited financial resources available to the project resulted in a process which took nearly 9 months to complete, delaying the publication by nearly that length of time.

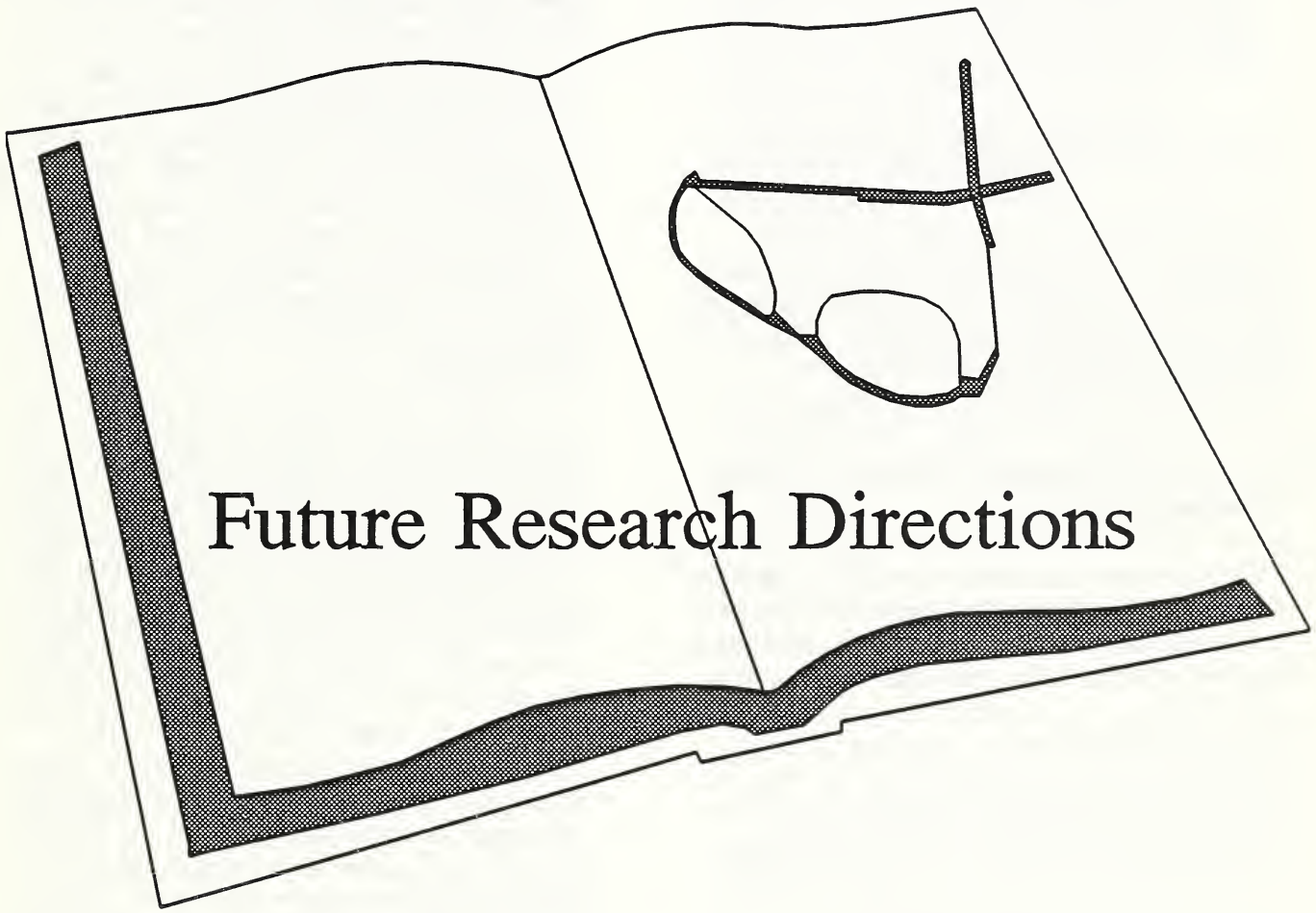
Although organized into twenty topical sections and indexed by author and by key words, the sheer number of references may make it difficult to identify papers dealing with subjects or concepts not included in these lists. All of the papers are recorded in FIREDOC so that any user of that system can search these records. By entering the logical statement **NFPRF=YES** and including this in the search strategy, the search will be limited to this collection as a subset of the nearly 40,000 current FIREDOC records. Access to FIREDOC is free of charge (except for the telephone call) and information on how to become a user is available from NIST.

The authors wish to thank the project sponsors, the Technical Advisory Committee, and the staff of the NFPRF for their support and guidance throughout the project. We especially wish to acknowledge the efforts of Wayne Moore, Dean Wilson, James Roberts, Frank Carideo, Rick Mulhaupt, and Susan Colgan in making this report a success.

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Future Research Directions

Introduction

This international bibliography of detection research was compiled to document the state-of-the-art, from which needed research could be identified and prioritized. The hope is that the research needs revealed by this effort can be pursued and more reliable detection system performance will result. To accomplish this the following questions must be answered:

- What are the primary goals for advanced fire detection systems?
- What is needed to achieve these goals?
- What is currently known?
- What is left to learn?
- How can this best be done?

In the following pages these issues will be addressed, but it should be understood that this represents the opinion of the author, and to a limited extent that of the Technical Advisory Committee who reviewed the report prior to publication. Until a consensus is reached among the detection industry, code officials, researchers, and risk managers as to these goals and priorities, these will remain just opinion.

What are the primary goals for advanced fire detection systems?

Clearly, we need to develop detection technology that can warn of unwanted fires before they pose a threat to people or property, while suppressing alarms for controlled combustion or other non-fire conditions. In the short term, we need to improve the performance of systems utilizing current detection technology and in the longer term, extract more information from current sensors and develop new sensors which might add to the data on which the systems depend.

CURRENT DETECTOR TECHNOLOGY

In the 1960's smoke detectors began to increase in popularity in commercial systems, but it was not until the residential smoke detector began to gain acceptance in the early 1970's that the rapid shift to *early warning life safety systems* took place. In these days there was a "horsepower race" between the ionization and photoelectric technologies as to who was fastest, which is at least partially responsible for today's false alarm problems. Further, since all smoke detectors were considered equal in the eyes of the codes, the cheapest unit generally won the bid. Today, low bid is still the rule rather than the exception. From these experiences we should have learned that we don't want the cheapest, most sensitive detector we can make.

In the past decade the NFPA Detection Devices Committee made a significant advance which is not generally appreciated. That is the concept, embodied in Appendix C of the NFPA Standard on Detection Devices, of the ***design fire***; and designing the detection system to respond to that design fire size. This concept recognizes the fact that a space can safely withstand a fire of a certain size, and only when it exceeds that size is there a threat to the building occupants. In some spaces that design fire is large enough that thermal detectors will serve quite well, saving cost and improving reliability without sacrificing performance. In other spaces where more fragile contents (including people) demand detection of much smaller fires, smoke detectors will be needed, but the number and sensitivity can be adjusted to allow for dirty vs. clean environments.

The concept of designing the response of detection systems to match the expected threat needs to be taken much further. There is much activity driven by advances in fire models and predictive methods, to characterize threats to all fire safety systems in terms of T-squared fires, often the same ones discussed in NFPA 72E. For example, the State of California is placing limits on the slope and peak rate of heat release of furniture in certain occupancies by their Technical Bulletin 133 (which has been adopted by six other states to date). Several countries (Australia, Canada, Japan, France, and Sweden) allow for fire models to be used to justify alternate designs for code acceptance. These often specify T-squared fires as design fires for this purpose.

As these techniques gain worldwide acceptance, the ability to *predict* the performance (activation time) of detection systems accurately will become crucial. With the addition of quantification of detection system reliability the complete operational role of these systems will be understood in relation to other active and passive fire protection features of any building. With similar predictive capabilities for sprinklers

(currently under development) and for fire resistant construction (also under study by a number of researchers) the complex interdependencies of these systems will be apparent.

Another key element in this approach is to understand smoke movement in an enclosure. We cannot continue to site detectors in a grid pattern and ***hope*** that the smoke gets to the detector. We need to understand such issues as stratification, "cold smoke", high air movement, ceiling obstructions, and other factors which affect where the smoke plume will end up. Most if not all of these issues can be addressed today using 2- and 3-dimensional field models. Systematic studies using these tools will yield sufficient knowledge to develop general installation guidelines applicable in most situations. And with the low cost of modern supercomputers this is economically feasible.

The bottom line is that we need to develop a sufficient level of understanding of how detection systems work that we can build computer models which are capable of accurately predicting real-world performance. Such models will lead directly to designs optimized for both cost and performance and a confidence that the system will perform as designed. It is just this type of confidence in detection systems which the false alarm problems has destroyed and which is leading to the search for solutions which do not include detectors.

MULTI-MODE DETECTION

Current detection systems provide a single bit of information - Has the concentration of particles exceeded the threshold level? If yes, there is a fire and if no, there is not. If we want to make a more informed decision to better discriminate for non-(unwanted) fire sources of these particles we need to collect more bits of information. This can be rate of change of signal (as in rate of rise heat detectors), or combinations of signals from different sensors - particle concentration and temperature and CO level.

This approach is currently being pursued by Japanese researchers for the purpose of not only deciding whether there is an unwanted fire, but also how rapidly it is growing and what level of threat it represents to building occupants given the time needed for the building to be evacuated. They would then tailor the response (people and equipment) needed to handle the situation. In another experimental system operating in Japan, three analog sensors on the ceiling of the room are used to triangulate and thus to identify the location of the fire to a specific quadrant of the room. By knowing the location of sensitive or particularly hazardous materials in the room, they know what is burning.

Swiss researchers have observed very small fluctuations in temperature (fractions of a degree) during flaming combustion, probably caused by local turbulence in the flame. By using a special thermal sensor that can detect these fluctuations and increase a smoke detector's sensitivity, they can improve performance and reduce false alarms.

NEW SENSORS

Nearly all current fire sensors are intended to be general purpose; that is, to detect any fire within the protected space. In some cases, it is possible to tailor the sensor to a specific characteristic of the principal fuel. An example is the use of hydrogen chloride sensors in telephone exchanges. They will quickly detect cable fires, but will ignore a burning printed circuit board (unless it contains chlorine in a coating). It also is possible to look for a compound that is intentionally added to items so that it is released when they burn or simply overheat. NASA is currently exploring this technology for the Space Station Project.

The common element in these examples is that they are detecting gases (to which we should not necessarily limit our thinking). The principal sensor technologies currently applied to gas detection include metal oxide semiconductors, electrochemical sensors (used in underground mines), and coated quartz crystal microbalance. However, there are a myriad of other sensors that might be used including stressed polymers, metal chelates, various infrared techniques, and surface acoustic wave. For general purpose detection, we can examine CO, CO_2, or oxygen depletion. Beyond gases, there might be new ways of measuring particle concentrations or new fire signatures such as acoustic. There needs to be a long term research program to examine the possibilities.

What is needed to achieve these goals?

The simple answer to this is ***Research***. In the early 1970's government and the industry invested significant resources into research to improve the single-station smoke detector and made a great deal of progress in a few years. Since then however, competition has resulted in a very low profit margin and little funds available for even short term studies. This situation needs to change.

The industry needs to commit to a long term program of research through both public and private sources. We need to re-institute the government/industry cooperative projects of two decades ago. The industry needs to *share* the fruits of this research and improve the entire industry at once. If they do not, other industries will assume dominance as the sprinkler industry currently is in health care occupancies. Just as the ionization vs. photoelectric controversy of 15 years ago was counter productive to the industry, without a commitment to work together the industry will not advance.

What is currently known?

The literature shows a significantly better understanding of the physics of the principal detection technologies than was apparent 15 years ago. This, coupled with advances in digital electronics which allow low cost analog systems that can collect and quickly process data on the time-history of smoke, temperature, and various gases at the panel, provides the potential for fire detection systems with a broad range of decision-making capabilities. Prototype systems under development today can not only distinguish threatening fires from normal activities, but they can tell what is burning and decide the best course of intervention actions to take. While such sophistication is not necessary for every installation, these technologies can potentially address most of the identified problems with current systems.

In most areas this literature review tells us that we know more than most of us thought we knew. A lot of the needed research has been started, but suffers from insufficient resources. We need to explore a number of technologies, sort out the most promising, and commit the resources necessary to advance them on an accelerated schedule. The exciting news is that much of the fundamental science needed to address most of the currently identified problems is in place waiting to be applied.

What is left to learn?

In the short term some new technology is needed, but the primary needs are to adapt and apply the existing knowledge identified in this review to the problems at hand. The standards and the industry itself, particularly in the US, has been slow to embrace new technology, preferring to wait until it is proven through experience.

Beyond advancing the technology of sensing systems, there is a need to better understand the influences of the room (e.g., ceiling configuration, obstructions such as pipes or cable trays, sloped ceilings), mechanical ventilation systems (e.g., high air flows, downflows used in clean rooms, or even flows in the vicinity of typical diffusers) and other effects (e.g., stratification, inversion layers near poorly insulated surfaces) on the transport of smoke particles and gases.

State-of-the-art computer modeling techniques can address these issues in a systematic way not possible with experimental studies. Only recently developed to the point that they can address the required fire physics, these models can predict the detailed distribution of particles and heat at the ceiling (or any other level) of a room from fires of widely varying sizes accounting for the effects of complex ceiling geometries or ventilation systems. This class of computational fluid dynamics models is used by NASA to study the flow around the space shuttle and by all of the major manufacturers in the world to design modern aircraft, completely replacing wind tunnel testing of physical models.

Parametric studies required to understand the influences of geometry or ventilation are orders of magnitude less costly to perform with models as experimentally and are not subject to the variability of fire tests which often cloud their interpretation. By revealing the detailed distribution of particulates and temperature in a way not possible to measure in actual tests the models would provide guidance not only on where to locate detectors, but also on which

detection principal(s) would be the best for the application.

At this stage, these models are not practical due to their cost and complexity as the means by which individual detection systems would be designed for specific installations. Thus the studies described here should be done and the results used to develop design guides, tables and graphs which can be included in the current installation standards.

In the longer term, government and industry need to invest in the development of new technology for both sensing and signal processing. Basic research on new fire gas sensing methods like surface acoustic wave devices needs to be pursued. The beginnings of application of techniques such as fuzzy logic and neural networks to detection systems have been identified in this review. Work in these areas needs to be expanded.

As the systems become more complex research needs to be done on the implications of this complexity to system reliability. Only a few such studies were identified in this area with none in the US. As fire hazard and risk analysis techniques become more common the interrelationships of various active- and passive fire protection systems will become better understood, with both performance and reliability representing key factors in the total building fire safety philosophy.

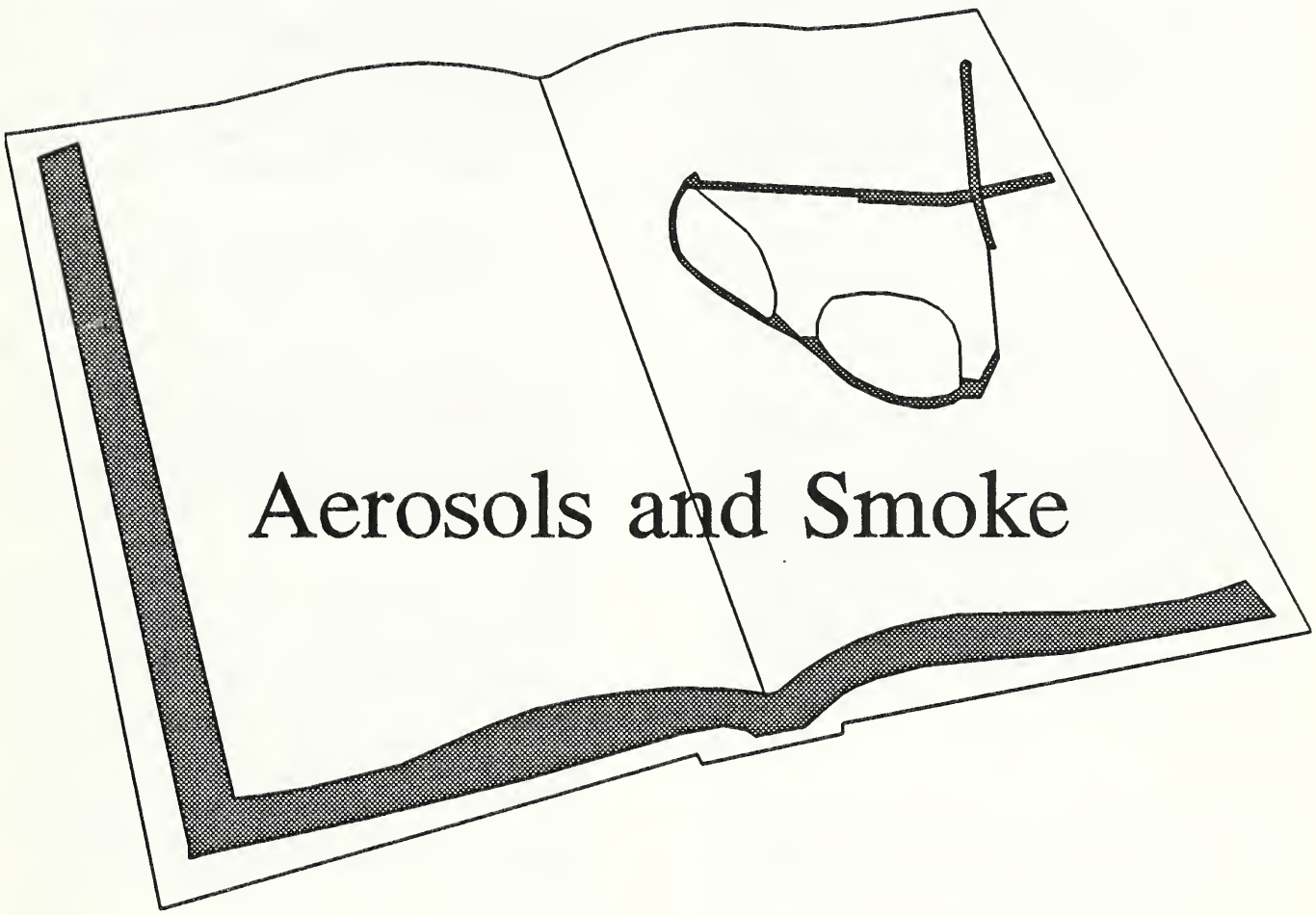
How can this best be done?

The first steps should be organizational. There is a need for a unifying organizational structure to coordinate the industry's position, which could be filled by the Fire Detection Institute or the Automatic Fire Alarm Association. Whatever organization is employed, it needs to be international in scope to facilitate a unified effort. This is particularly needed since many of the US companies are owned by non-US organizations and because the EC and ISO activities are resulting in common markets and standards.

Once organized, the needed long term commitments to research need to be made and the work undertaken. Basic technologies should be shared, but the application of these technologies can remain proprietary. This means that the industry needs to support the external research and commit to implementing the results.

The key requirement is to work together toward a common set of goals and following a plan representing a consensus of opinion of the industry, research, government, academia, owners, and regulatory communities. The commitment must be real and the resources allocated sufficient. The detection industry cannot expect someone else to address their problems.

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Aerosols and Smoke

Most of the work presented in this section is a decade old, representative of the surge in fire-aerosol research in the early 1980's. These papers deal primarily with aerosol characteristics - size and number distribution, coagulation rate, and optical properties as measured on smokes produced by materials used in detector evaluation under both US and European standards. Also included are several review articles which derive from the US/Japan Cooperative Panels on Fire Research (the UJNR) which are held every 2-3 years.

More recent papers deal with the VESDA (optical, sampling) system from Australia [Notarianni 1989 and Hartnell, 1987] or condensation nuclei [Drake, 1989] detectors or with theory [Yamauchi, 1986 and 1988, Baum *et al* 1984, and Mulholland *et al* 1982]. The Japanese have done some work with multiple wavelength light scattering [Hirono *et al* 1991] relative to its potential application to discriminate against non-fire signatures which follows prior work in the US by Cashdollar at Factory Mutual.

The peak and subsequent decline of interest in research into the quantification of fire aerosol properties followed the development of a number of instruments for the air pollution field in the early 1980's and the discovery of problems in their application to fire aerosols (e.g., saturation due to very high particle concentrations) a few years later. While some new instruments have been developed in the past few years (e.g., the Tapered Element Oscillating Microbalance) there has not been renewed interest in this research area. With the coming of analog detectors there should be more work done, particularly related to discrimination of non-fire aerosol signatures.

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The extinction beam photometer is the most widely used instrument for taking smoke measurements in fire testing. Most existing designs were found to be inaccurate and unreliable for measurements where smoke detection performance is evaluated due to the low levels of smoke present at activation.Accordingly, a new extinction beam photometer design was developed which will provide the stability and accuracy necessary for these measurements. The paper describes the new design and proposes its adoption as an industry standard. The paper also discusses the need for a reference ionization chamber instrument and a reference measurement which relates to gas sensing fire detectors.

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Institute for Electronics Communication Technology of the Rheinish-Westfalian Technical College, Aachen. Colloquium on Aerosol Measurement Techniques. March 4, 1975, Aachen, West Germany, 45-58 pp, 1976. NBSIR 76-1037 Available from National Technical Information Services PB-253933
aerosols; ionization chambers; light scattering; smoke detectors; test methods
In assessing the performace of smoke detectors in the laboratory, it is necessary to have standardized smoke measurement devices which function according to the same principles as the smoke detectors under test. In developing these measurement devices, a need exists to determine, as precisely as possible, the effects of the smoke characteristics on the measurement devices. This paper presents the correlation between smoke characteristics and comparative measuring devices important in smoke detector test work and how these measuring devices also can be used as aerosol measuring devices.

Lee, T. G.

Lee, T. G.; Mulholland, G.
Physical Properties of Smokes Pertinent to Smoke Detector Technology.
Final Report. National Bureau of Standards, Gaithersburg, MD
NBSIR 77-1312;45 p. November 1977.
Available from National Technical Information Services PB-274330
aerosols; size distribution; smoke; smoke detections; test methods
Several commercially available aerosol instruments including the electrical aerosol analyzer, nuclei condensation monitor, quartz mass monitor, and optical

particle counter were used to measure particle size distribution of smokes from burning heptane and cellulosic materials.Some limitations of these instruments are discussed.Parameters such as mode of exposure (flaming versus smoldering), pyrolysis temperature, air velocity at smoke emitting site, and aging were found to have a large effect on the smoke particle size distribution.Mass and number concentration of smokes from cotton lamp wick as a function of smoke obscuration in the standard UL 217 detector test chamber were determined.The maximum alarm threshold obscuration of 0.06 OD/m (4% per ft), required for detector approval, was found to correspond to lamp wick aerosol mass concentration of 40 mg/m(3) and particle concentration of about 4 x 10(6) cm(-3) with the peak size in the number distribution of about 0.15 mu m.The present UL 217 test method was shown to be affected by smoke coagulation and did not provide a complete measure of sensitivity in smoke detectors.An algebraic model size distribution, with number and mass concentration the only free parameters, was shown to provide a good estimate for all the smoke size distributions measured.

Levine, R. S.

Levine, R. S.
Detection and Smoke Properties.
National Bureau of Standards, Gaithersburg, MD
U. S./Japan Government Cooperative Program on Natural Resources.Panel on Fire Research and Safety. Volume 6. Fire Detection.October 19-22, 1976, Tokyo, Japan, 1-31 pp, 1976.
fire detection; fire research; fire safety; fire detectors; smoke detectors; sensitivity; false alarms; heat detectors; ionization detectors; taguchi gas sensor (trademark); photoelectric detectors; ultraviolet detectors; smoke generation; light scattering
In this paper I will first briefly view the state-of-the-art capabilities of difference kinds of detectors, then discuss smoke research that is relevant to properties that should be measured to make detectors more reliable and sensitive to real fires, and free of false alarms.

Lorbeer, G.

Lorbeer, G.; Siemund, B.; Willms, I.
Opto-Computer-Tomographical Methods as Aids for Characterizing Local Inhomogeneous Aerosol Distributions.
Duisburg Univ., F.R.G.
Journal of Aerosol Science,Vol. 15, No. 3, 287-291, 1984.
aerosols; sensors; extinction; encolsures aerosol flows in closed system

Lorbeer, G.; Siemund, B.; Willms, I.
Reconstruction of Aerosol Distribution Images Using Computer Tomographical Methods.
Duisburg Univ., Federal Republic of Germany
Signal Processing:Theories and Applications. European Conference, 2nd Proceedings EUSIPCO-83.1983, Elsevier Publishers B.V., North Holland, Schussler, H. W., Editor, 617-620 pp, 1983.
aerosols; computers; data processing
A description of a computer tomographical method is given, which is being applied to measurements of local inhomogeneous aerosol distributions.Improvements of a corresponding data processing system are discussed on the basis of calculations of the computing speed necessary for real time operation of the system. These improvements mainly concern the use of a modified array processor with a simple structure.In addition an overview is given over the essential characteristics of the system studied in model investigations. An outlook on future works closes the paper.

Luck, H. O.

Luck, H. O.; Siemund, B.; Lorbeer, G.
Measurement of Spatial Aerosol Distributions in Enclosures by Means of Computed Tomography.
Duisburg Univ., Germany
Particle Characterization, Vol. 2, 137-142, 1985.
aerosols; encolsures; extinction; wood; density effects
A measurement method that approximates the spatial distribution of inhomogeneously distributed aerosols in a limited measurement plane is described.It is based on the evaluation of a comparably small number of infrared extinction measurements taken from the measurement plane boundary.The measured data are processed by means of computed tomography. The results are displayed on a monitor in a color-coded picture of the aerosol-"density"-pattern. The basic design and the principal characteristics of the method are mathematically described and verified by simulation tests and practical results which are obtained from an experimental set up using smoldering wood as an aerosol source.

Miyama, J.

Miyama, J.
Report of Technical Session on Detection and Smoke Properties.
National Bureau of Standards.
Fire Research and Safety. 3rd Joint Panel Proceedings Conference of the U.S. Japan Cooperative Program in Natural Resources. March 13-17, 1978, Gaithersburg, MD, National Bureau of Standards, NBS SP 540, Sherald, M. A., Editor, 713 pp, 1979.
Available from Government Printing Office SN-003-003-02141-5
detection; smoke

Miyama, J.; Saito, F.
Fire Detection and Smoke Property.
Sophia Univ., Tokyo, Japan Building Research Inst., Tokyo, Japan
U.S./Japan Cooperative Program in Natural Resources. Fire Research and Safety.5th Joint Panel Meeting. October 15-24, 1980, Gaithersburg, MD,NBS SP 639, Chidester, J. E., Editor, 31-38 pp, 1982.
Available from Government Printing Office
fire detection; fire protection; experiments; smoke detectors; fire alarm systems; visibility; smoke
This paper consists of two parts. Part I consists of two reports on fire experiments in full-scale houses, comparative study on the absorption of visible and infrared ray in smoke, a report on the study of beam-type smoke detectors, and several recent developments on smoke detectors and fire alarm systems. Part II discusses the formation of smoke particles to apply the results of the study of fire detection and escape from fires.

Miyamoto, M.

Miyamoto, M.; Matsushima, O.; Matsuda, S.
Fire Detection System in a Telephone Office Building and a Study of the Smoke Layer Forming Process.
Nippon Telegraph and Telephone Public Corp., Tokyo, Japan; Nippon Telegraph and Telephone Public Corp., Musashino-City, Japan; Conseil International du Batiment (CIB). Systems Approach to Fire Safety in Buildings. Volume 2. Session 3. Active Systems Performance and Criteria:Smoke Control, Detection, Sprinklers. Session 4. Passive Systems Performance and Criteria:Combustibles, Fire Resistance. August 29-30, 1979, Tsukuba, Japan, III/13-27 pp, 1979.
fire safety; fire detection systems; telephones; office buildings; smoke

Morikawa, T.

Morikawa, T.
Retardation of Black Smoke and Soot Generation From Building Materials.
Fire Research Inst., Mitaka-City, Japan; Conseil International du Batiment (CIB). Systems Approach to Fire Safety in Buildings.Volume 2. Session 3. Active Systems Performance and Criteria:Smoke Control, Detection, Sprinklers.Session 4.Passive Systems Performance and Criteria:Combustibles, Fire Resistance. August 29-30, 1979, Tsukuba, Japan, IV/61-71 pp, 1979.
fire safety; smoke; soot; building materials; combustion

Mulholland, G. W.

Mulholland, G. W.
How Well Are We Measuring Smoke?
National Bureau of Standards, Gaithersburg, MD
Fire and Materials,Vol. 6, No. 2, 65-67, June 1982.
smoke measurement; fire research
Estimates of the errors in light extinction measurements of smoke resulting from forward scattered light entering the detector and from the spectral width of the light source are presented.It is shown for specific examples that each of these effects can lead to an error of about 25% in typical applications.

Mulholland, G. W.; Lee, T. G.; Baum, H. R.
Coagulation of Aerosols With Broad Initial Size Distributions.
National Bureau of Standards, Gaithersburg, MD
U.S./Japan Government Cooperative Program on Natural Resources.Panel on Fire Research and Safety. Volume 6. Fire Detection. October 19-22, 1976, Tokyo, Japan, 1-49 pp, 1976.
fire detection; fire research; fire safety; size distributions; aerosols; coagulation; particle size; smoke; smoldering
The effect of coagulation on an aersol with a broad initial size distribution was calculated analytically for large and small particle sizes for arbitrary time with the assumption of a constant coagulation collision frequency.It was found for the class of algebraic initial distributions that in general there is no self-preserving size distribution though for the special case of a Junge like algebraic size distribution there is a quasi self-preserving form. The calculation also demonstrates that coagulation alone leads to dynamic equilibrium for large particle size without the need of additional physical processes such as particle sedimentaion.The relevance of the calcualtions to real aerosols was tested by measuring the size distribution of smoke generated from smoldering "punk" and flaming alpha-cellulose.The size distributions of both smoke aerosols are not only self-preserving but also are very similar. there is quantitative agreement between the measured size distributions and the calculated quasi self-preserving form.

Mulholland, G. W.; Ohlemiller, T. J.
Aerosol Characterization of a Smoldering Source.
National Bureau of Standards, Gaithersburg, MD
Aerosol Science and Technology,Vol. 1, 59-71, 1982.
aerosols; smoldering combustion; combustion products; mass flow; particle size distribution; plumes; sampling
The aerosol emitted by a moderately large smoldering combustion source (16 cm in diameter) has been characterized in detail. The fuel is a permeable bed of cellulosic insulation (wood fibers) receiving its primary air

supply by flow up from the botton of the bed whice the smolder wave propagates downward.The mass mean particle size of the aerosol is 2-3 mum; this shows no clear trend with smolder wave depth in the bed or with air flow velocity.The large average particle size is shown to imply that, compared to punk smoke, the present aerosol requires a sevenfold greater concentration to trigger an ionization detector. Coagulation of the aerosol in the plume above the source is shown to be minimal, but substantial coagulation can occur within the source.The apparent fractional conversion of gasified mass (60-75% of the fuel) to aerosol mass decreases with smolder wave depth in the bed and with decreasing air flow rate. The mass and number flow rate of the aerosol show these same trends. The decreasing aerosol emissions with wave depth or air flow rate are plausibly explained by filtration effects in the smolder bed.

National Bureau of Standards

National Bureau of Standards
Areas of Progress in Smoke Detection and Aerosol Research at NBS Since 1978 UJNR Meeting.
National Bureau of Standards, Washington, DC
U.S./Japan Government Cooperative Program on Natural Resources (UJNR).Fire Research and Safety.4th Joint Panel Meeting.February 5-9, 1979, Tokyo, Japan, 174-175 pp, 1979.
smoke detection; aerosols; smoke detectors

National Bureau of Standards
Researches in Smoke Properties in Japan.
Japanese Association of Fire Science and Engineering
National Bureau of Standards.
Fire Research and Safety. 3rd Joint Panel Proceedings Conference of the U.S. Japan Cooperative Program in Natural Resources. March 13-17, 1978, Gaithersburg, MD, National Bureau of Standards, NBS SP 540, Sherald, M. A., Editor, 54-101 pp, 1979.
Available from Government Printing Office SN-003-003-02141-5
smoke

The countermeasures to smoke produced in fires of buildings are very important for the safety of people.An effective design for fire safety is required to establish the reasonable countermeasures based on the knowledge of characteristic of smoke released. There may be two categories for countermeasures of smoke in fires. That is, one is to control the generation of smoke and the other is to control the flow of smoke released in buildings. The methods of the study of the former subject are essentially different from those of the latter.The cooperative studies between the two categories have been carried out for many years by fire research people. The Committee of Japan Association of Fire Science and Engineering involves a subcommittee which studies on smoke and toxic gas load relating to the countermeasures to smoke in fires. Information on mechanism of generation, property and quantity of smoke from various materials in fires have been exchanged and the fundamental studies on characteristic of smoke have been studied for many years at the subcommittee. The smoke behavior in compartment fires have also been studied.This report is the summary of some main reports which have been discussed at the subcommittee on mechanism and generation of smoke from materials and smoke generation in compartment for the contribution to the 3rd Panel Meeting UJNR Panel on Fire Research which involves Technical Session on "smoke property and detector".

National Fire Prevention and Control Administration

National Fire Prevention and Control Administration
Smoke Detector Resource Catalog.
National Fire Protection and Control Admin., Washington, DC
41 p. June 1977.
smoke detectors

National Fire Prevention and Control Administration
Smoke Detector Technology.
National Fire Prevention and Control Admin., Washington, DC
5 p. July 1977.
smoke detectors

Notarianni, K. A.

Notarianni, K. A.
Modeling and Design of Equal Sampling-Rate Multi-Orifice Dynamic Smoke Detection Sampling Tube Networks.
Worcester Polytechnic Institute, MA Thesis; 91 p. August 1988.
continuous sensors; detection time; detector sensitivity; fire detection systems; light scattering; mass transfer; sampling; smoke detectors; smoke measurement; smoke transport

Pfister, G.

Pfister, G.
Detection of Smoke Gases by Solid State Sensors--A Focus on Research Activities.
Cerberus AG, Mannedorf, Switzerland
Fire Safety Journal,Vol. 6, No. 3, 165-174, 1983.
smoke; fire alarm systems; aerosols; fire detectors analysis of smoke gases; solid stage gas sensor

Pistor, M.

Pistor, M.
System for Measuring the Determination of the Particle Size Distribution of Test Fire Aerosols.
Gesamthochschule Duisburg, Berlin, Germany
186 p. February 20, 1978.
aerosols; particle size; size distribution; fire alarm systems; fire protection; smoke detectors

Pistor, M.; Fissan, H. J.
Bestimmung der Partikelgrossenverteilung von Testbrandaerosolen. [Determination of Particle Size Distribution from Aerosols of Test Fires.]
Staub-Reinhaltung der Luft,Vol. 38, No. 2, 63-64, February 1978. Kongressbericht der Gesellschaft fur Aerosolforschung e. V., Karlsruhe.October 1977, 204-209 pp, 1977.
In:German
aerosols

Pucill, P. M.

Pucill, P. M.
Development of Automatic Fire Detection Equipment.
AFA Minerva (EMI) Ltd., England; Fire Service Technical College.
Automatic Fire Detection in Non-Domestic Residential Premises. Technical Study Paper 2.
April 3-5, 1978., Gloucestershire, England, 7-12 pp, 1978.
fire detectors; fire detection; smoke detectors; life safety

Roos, R. A.

Roos, R. A.; Dutertre-Laduree, D.
Optical and Electrical Measurement of Aerosols Produced by Normalized Fires.
Laboratoire de Physique des Decharges, Gif sur Yvette, France Capsor S.A., Cravent, France
Journal of Aerosol Science, Vol. 20, No. 8, 1509-1512, 1989. Institut fur Experimentalphysik der Universitat Wien. European Aerosol Conference, 1989.Abstracts of the 17th Annual Conference of the Association for Aerosol Research. September 18-23, 1989, Vienna, Austria, Preining, O. and Georgi, B., Editors, 1989.
aerosols; fire detection systems; combustion; electrostatic charges

Siemund, B.

Siemund, B.
Measurement of Aerosol Parameters With Sonic Waves.
Duisburg Univ., Federal Republic of Germany
Aerosols:Formation and Reactivity.
International Aerosol Conference, 2nd.September 22-26, 1986, Berlin (West), Pergamon Press, New York, 1189-1191 pp, 1986.
aerosols; waves; ultrasonics; optical measuring instruments; computers; tomography

Thomas, P. H.

Thomas, P. H.
Smoke Control in Compartmented Buildings.
Fire Research Station, Borehamwood, England
CIB Working Paper Pub. 72;39 p. 1983.
smoke control
Everybody knows how rapidly, in case of fire, a building is filled with smoke. Fire reports point out the very short time which elapses between the moment of the initial detection of the fire and the moment when smoke is present in significant amounts in areas distant from the seat of the fire. Compartmented buildings present a certain degree of risk of being invaded with smoke even where doors, dampers and fire-rated walls and floors are present.This is especially critical in tall buildings where there are vertical ducts and shafts for stairwells, elevators, and mechanical services. It is frequently observed that smoke from a fire at low level will invade the upper stories of a tall building.

Vanck, R. M.

Vanck, R. M.; Bernigau, N. G.
On an Electrical Method to Determine the Particle Size Distribution of Polydisperse Aerosols.
Duisburg Univ., Federal Republic of Germany
Aerosols:Formation and Reactivity.International Aerosol Conference, 2nd.September 22-26, 1986, Berlin (West), Pergamon Press, New York, 1204-1207 pp, 1986.
aerosols; particle size distribution; equations

Watanabe, A.

Watanabe, A.
Recent Japanese Research on Fire Detection and Properties of Smoke.
Fire Research Institute, Japan
U.S./Japan Government Cooperative Program on Natural Resources, Panel on Fire Research and Safety. Volume 6. Fire Detection. October 19-22, 1976, Tokyo, Japan, 1-21 pp, 1976.
fire detection; fire research; fire safety; smoke; smoke detectors; residential buildings; computers; room fires; gas sensors

Watanabe, A.; Miyama, J.; Saito, F.; Suzuki, H.
Progress Report on Fire Detection and Smoke Properties.
Fire Research Inst., Tokyo, Japan; Sophia Univ., Tokyo, Japan; Building Research Inst., Ibaraki-ken;
U.S./Japan Government Cooperative Program on Natural Resources (UJNR). Fire Research and Safety.4th Joint Panel Meeting.February 5-9, 1979, Tokyo, Japan, CIB W14/81/05 (J), 161-167 pp, 1979.
fire detection; smoke; fire protection

Weiner, A. M.

Weiner, A. M.; Harris, S. J.
Optical Detection of Large Soot Precursors.
General Motors Research Labs., Warren, MI
Combustion and Flame, Vol. 77, No. 3 & 4, 261-266, September 1989.
soot; molecular weight; absorption

Welker, R. W.

Welker, R. W.; Wagner, J. P.
Particle Size and Mass Distributions of Selected Smokes. Effect on Ionization Detector Response.
Gillette Research Inst., Rockville, MD;
Journal of Fire and Flammability, Vol. 8, 26-37, January 1977.
detector response; particle size; smoke tests; ionization detectors; smoke generation

Yamauchi, Y.

Yamauchi, Y.
Numerical Simulations of Smoke Movement and Coagulation.
Hochiki Corp., Tokyo, Japan;
International Association for Fire Safety Science. Fire Safety Science. Proceedings. 1st International Symposium. October 7-11, 1985, Gaithersburg, MD. Hemisphere Publishing Corp., NY, Grant, C. E. and Pagni, P. J., Editors, 719-728 pp, 1986.
smoke detectors; aerosols; enclosures; detector sensitivity; fire detectors; particle size; room fires; simulation

Yamauchi, Y.
Prediction of Response Time of Smoke Detectors in Enclosure Fires.
National Bureau of Standards, Gaithersburg, MD
NBSIR 88-3707;52 p. January 1988.
Available from National Technical Information Services PB88-169883
smoke detectors; computer programs; fire models; ionization detectors; particle density (concentration); photoelectric detectors; response time; zone models
In order to predict the response time of smoke detectors in enclosure fires, a computational model is developed for calculating the local particulate concentration near the ceiling. The large scale smoke movement is approximated by integral equations for plume and ceiling-jet, which originates in the cold lower layer and penetrates into the accumulated smoke layer in the upper portion of enclosure. The effect of coagulation, which changes the particle size distribution, is included to enable predictions of ionization smoke detector response. This engineering model is designed to be used in combination with two-layer zone models for obtaining more detailed information of smoke concentraion in the upper layer.Sample calculations have been made and comparisons with relevant experimental data showed a reasonable agreement both in the mass concentration and particle number concnetration of smoke in the ceiling-jet.

Zinn, B. T.

Zinn, B. T.; Powell, E. A.; Cassanova, R. A.; Bankston, C. P.; Tsoukalas, S. N.; Rhee, J. U.
Analysis of Smoke Produced During the Thermal Degradation of Natural and Synthetic Materials.
Georgia Institute of Technology, Atlanta
U.S./Japan Government Cooperative Program on Natural Resources.Panel on Fire Research and Safety. Volume 6. Fire Detection. October 19-22, 1976, Tokyo, Japan,1-48 pp, 1976 AND
University of Utah.International Symposium on Toxicity and Physiology of Combustion Products. March 22-26, 1976, Salt Lake City, UT, 1976
fire detection; fire research; fire safety; synthetic materials; smoke; thermal degradation; physical properties; chemical properties; wood; rigid foams; plastics; test chambers; building materials; combustion products



Aircraft

The majority of the work published on this topic deals with the detection of in-flight fires in engines, typically by optical techniques operating in either the IR or UV bands. Next is the detection of fires in other aircraft spaces (e.g., cargo holds) using particulate detection (either spot or sampling) and finally, fire detection in hangers or "forward shelters" - fighter aircraft hangers located just behind the front lines where aircraft are re-armed and re-fueled, typically with the pilot on board and the engine running.

The papers in this section should be of particular interest to those involved in the protection of industrial hazards since the detectors must operate in a hostile environment and differentiate the fire from that environment. The fuels are typically hydrocarbon liquids and reaction times must be short.

Finally, there are several papers on testing devices for these detectors [Shelbourn 1990 and Hawkins 1984] which might hold promise in testing other detection systems. A paper on smoke detector response to aircraft interior materials [McKee 1990] and one on time domain reflectometry [Hannum 1990] applied to linear heat detection cable should be of interest.

Aircraft Engineering

Aircraft Engineering
Fire Detection and Extinguishing System Designed for Concorde.
Aircraft Engineering, Vol. 49, No. 10, 8-11, October 1977.
aircraft engines; aircraft safety; false alarms; fire detectors; fire fighting equipment; fire protection; safety

Blake, D. R.

Blake, D. R.
Suppression and Control of Class C Cargo and Compartment Fires. Final Report. August 1983-June 1984.
Federal Aviation Admin., Atlantic City, NJ
DOT/FAA/CT-84/21; 31 p. February 1985.
Halon 1301; fire suppression; cargo space; compartment fires; smoke detectors; aircraft fires; small scale fire tests; aircraft compartments; fire fighting; burnthrough (failure); combustion; linings; warning systems; interior finishes; ceilings
A total of 23 fire tests were conducted in a 2357-cubic foot simulated class C cargo compartment. Various lining materials, fire sources, loading configurations, and smoke detectors were used to determine the ability of class C cargo compartments to control fires. The simulated class C cargo compartment did not successfully control the test fires in all cases. The major conclusion of this study is that the 45 bunsen burner test specified in FAR 25.855 does not assure that cargo liners will not burn through when subject to realistic fires.

Blake, D. R.; Hill, R. G.
Fire Containment Characteristics of Aircraft Class D Cargo Compartments. Final Report. August1981- September 1982.
Federal Aviation Admin., Atlantic City, NJ
DOT/FAA/CT-82/156; 40 p. June 1983.
Available from National Technical Information Services N83-27968
class D fires; oxygen concentration; aircraft compartments; ceilings; fire prevention; smoke detectors; fire tests; aircraft fires; small scale fire tests; thermocouples; ventilation
Eighteen tests were conducted in a 640-cubic foot simulated class D cargo compartment test article. Various ceiling lining materials, cargo loading configuration, air leakage rated, and fire sources were examined in an effort to determine the conditions likely to occur during a class D cargo compartment fire. The lining materials used in this project passed the requirements of FAR 25.853 and 25.855 (vertical and forty-five degree bunsen burner lab tests); however, they did not always successfully contain the cargo fires. The major conclusion of this study is that FAR 25.853 and 25.855 do not insure adequate burn-through resistance of class D cargo liners subjected to realistic fires.

Blomberg, R. D.

Blomberg, R. D.; Bishop, E. W.; Hamilton, J. W.; Custer, R. L. P.
Technology Assessment for Aircraft Command in Emergency Situations. Final Report. April 28,1987-May 31, 1988.
Dunlap and Associates, Inc., Norwalk, CT
Worcester Polytechnic Inst., MA

DOT/FAA/CT-88/20; DA88-1; 133 p. October 1988.
Available from National Technical Information Services
emergencies; fire detection; smoke detection; in-flight fires

Blumke, R. E.

Blumke, R. E.
Aircraft Cargo Compartment Fire Test Simulation Program.
Final Report. October 1974-January 1977.
McDonnell Douglas Corp., Long Beach, CA
NASA CR-151951; MDC-J7471; 77 p. January 1977.
Available from National Technical Information Services N78-21223
aircraft compartments; flammability; simulation; burning rate; combustion; fire damage; fire extinguishers; ignition limits
Fire containment and fire extinguishment in cargo was studied by reducing the ventilation through the cargo compartment. Parameters which were measured included ignition time, burnthrough time and physical damage to the cargo liner, composition of selected combustible gases, tempeature-time histories, heat flux and detector response.

Calhoun, R.

Calhoun, R.; Risinger, C. W.
Aircraft Fire Sentry. Final Report. December 1984-September 1987.
New Mexico Engineering Research Institute, Albuquerque, NM
AFESC/ESL-TR-87-70; NMERI-WA3-43-(3.09); 108 p. July 1988.
Available from National Technical Information Services AD/A-213797
military aircraft; fire detection; fire suppression; fire protection; halon 1211

Farquhar, R. L.

Farquhar, R. L.; Ball, D. N.
New Systems Make for Safer Aircraft.
Graviner Limited, England
Fire International, No. 111, 32,34-35, June/July 1988.
aircraft safety; fire protection; military aircraft

Fire International

Fire International
Linear Heat Detection for Special Airport Risks.
Fire International, No. 82, 49-50, August/September 1983.
heat detection; airports; fire detection

Fire International
Swiss Detection System for Frankfurt Hangar.
Fire International, No. 82, 55-56, August/September 1983.
fire detection systems; false alarms

Fox, D. G.

Fox, D. G.
Aircraft Hazard Detection and Control Utilizing an Aircraft Data Acquisition System. Final Report. July1970-July 1974.
Air Force Aero Propulsion Lab., Wright-Patterson AFB, OH
AFAPL-TR-77-77; 89 p. December 1977.
Available from National Technical Information Services AD/A-054416
aircraft crash equipment; fire hazards; detectors; warning systems; vapors; fuels; smoke; fire detectors; cost benefit systems; reliability
The feasibility of using an aircraft multiplexed data acquisition system for on-board aircraft hazard detection and control are discussed. The hazards of primary interest are fire, explosion, overheat, smoke and explosive vapors. Hazard control involves systm shutdown as well as activation of extinguishing systems and other active protectipart of the total aircraft data system requirements.

Fox, D. G.
Development of Electronic Circuits for Advanced High Temperature Detectors. Final Report. July 1,1973-June 30, 1975.
Air Force Aero Propulsion Lab., Wright-Patterson AFB, OH
AFAPL-TR-75-111; 42 p. March 1976.
Available from National Technical Information Services AD/A-023843
fire detectors; ultraviolet detectors; infrared detectors; high temperature
This program was directed toward developing electronic circuits for advanced high temperature infrared and ultraviolet fire detectors which had been developed by the laboratory. A circuit which is applicable to any gas discharge type of UV sensor did not perform reliably above 600F. A circuit for a 750F infrared fire detector was developed and performed satisfactorily. The circuit uses the flicker phenomenon of fuel type fires to distinguish the fire from background sources. This circuit is applicable to any similar solid state infrared sensor.

Fox, D. G.
Investigation of Titanium Combustion Characteristics and Suppression Techniques. Final Report. January 1, 1974-March 1, 1975.
Air Force Aero Propulsion Lab., Wright-Patterson AFB, OH
AFAPL-TR-75-73; 66 p. February 1976.
Available from National Technical Information Services AD/B-010507
titanium; combustion; argon; fire extinguishing agents; air flow; burning rate; fire detectors; ultraviolet detectors; combustion chambers; ultraviolet radiation; test facilities; gas turbine engines. This test program studies the burning characteristics of titanium under air flow conditions. The flat plate titanium samples are ignited by molten titanium from an electrically heated ignitor. Air flow conditions that support sustained combustion of a single sample are determined. The burn rate is measured on all tests with steady state burning. Argon gas is shown to be a feasible extinguishing agent for a titanium fire. Quick injection of a sufficient amount of argon gas to maintain a 60% concentraion by volume of argon results in quick suppression by oxygen depletion. Carbon dioxide (CO2), a common fire extinguishing agent, is shown to sustain titanium burning at an accelerated rate. The ultraviolet (UV) radiation emitted by burning titanium is shown to sustain titanium emitted by burning titanium is shown to be a sufficient intensity for existing UV fire detectors to detect at reasonable distances.

Hannum, A. J.

Hannum, A. J.; Weisbrod, S.
Time Domain Reflectometry Overheat Detection System. Final Report. January 1970-January 1971.
Teledyne/Micronetics, San Diego, CA
AFAPL-TR-71-15; 93 p. February 12, 1971.
Available from National Technical Information Services AD-723308
temperature warning systems; fire safety; coaxial cables; time lag; false alarms
The report is concerned with the utilization of thermally sensititive, electrical transmission lines for the detection and measurement of thermal hazard, or conditions in an aircraft. Use is made of a coaxial cable which changes its electrical properties drastically as the temperature passes through a predetermined (alarm) temperature. Short duration electrical pulses pass down the transmission line and are reflected by the overheated section, with the time delay proportional to the distance between the input and the overheated section. A system results which determines both the presence of the overheat condition and gives information relating to the position of the overheat. The latter may be displayed to an observer, or utilized in the system to improve discrimination against false alarms. Pursuant to the development of a prototype system design, several candidate cables and cable materials were investigated. These included brief tests of lines using semiconductor and lithium glass material, with more extensive testing of ferrite and slat dielectric lines. The prototype system employs salt dielectric cables; it utilizes 100 percent redundancy of the pulse circuitry, and an independent cable fault detection circuit, built-in test functions, and a display which indicates alarms, equipment condition, and cable condition, and indicates position of overheat. It is concluded that the employment of the pulse reflection techniques for overheat detection is entirely feasible. Operational systems can result from development of improved cables.

Hawkins, R. L.

Hawkins, R. L.; Rao, K. N.
Standard Aircraft Diffusion Flame: Spectral Characteristics and a Feasibility Study for Developing an Alternate Calibration Source for Aircraft Optical Fire Detection Systems. Final Report. March 31, 1983-September 30, 1984.
Ohio State Univ., Columbus, OH
AFWAL-TR-84-2080; 23 p. December 30, 1984.
diffusion flames; aircraft fuels; fire detection systems; calibrating; soot; carbon dioxide; fire detection; radiant flux profile; smoke detectors; spectrometers; thermal radiation
The standard aircraft diffusion flame source presents practical difficulties due to its lack of controllability and its production of large amounts of smoke and soot. A source which is more convenient to handle, but which emulates the spectral and power characteristics of the standard flame, might prove useful. The requirements of such a flame were evaluated by measuring the spectral and power characteristics of a standard aircraft diffusion flame over the spectral range 2.5 to 20 microns. The total power output in this range was on the order of 1000 watts. About one-fourth of this was from the 4.4 micron carbon dioxide emission band; a small amount was due to weaker emissions of water vapor and carbon dioxide; the remainder was due to thermal emission from soot particles.

Hill, R. G.

Hill, R. G.
Flight Test of a Self-Generating Overheat Detection System.
Final Report. October 1972-September 1975.
Federal Aviation Admin., Atlantic City Airport, NJ
AFAPL-TR-76-01; 18 p. January 1976.
aircraft engines; overheating; nacelle fires; warning systems; flight tests

HTL Industries, Inc.

HTL Industries, Inc.
Test and Evaluation of U.V. Fiber Optics for Application to Aircraft Fire Detector Systems. Final Report.May 1980-March 1981.
HTL Industries, Inc., Duarte, CA
AFWAL-TR-81-2049; 59 p. June 1981.
aircraft; fire detection systems; fiber optics; fire detection; flame models
It was found that in the U. V. solar blind region, there are severe limitations on the field of view obtainable in Fiber Optic coupled systems. These restrictions are such as to make further consideation of the wide angle system concept unprofitable. This effectively limits the use of such systems in fire detection to applications where the precise location of a flame can be predicted. It is concluded that the performance of optical fibers in the U. V. solar blind wavelengths is such that the trade-off gains proposed in AFAPL-TR-78-84 cannot be realized in practice.

Johnson, A. M.

Johnson, A. M.
Optical Fire Detector Testing in the Aircraft Engine Nacelle Fire Test Simulator. Final Report. July 1985-October 1986.
Boeing Advanced Systems, Seattle, WA
AFWAL-TR-87-2089; 82 p. March 1988.
fire detectors; aircraft engines; nacelle fires; fire tests; sensitivity; fire detection

Johnson, A. M.; Grenich, A. F.
Vulnerability Methodology and Protective Measures for Aircraft Fire and Explosion Hazards. Volume 2. Aircraft Engine Nacelle Fire Test Program. Part 1. Fire Detection, Fire Extinguishment and SurfaceIgnition Studies. Final Report. February 1981 to October 1984.
Boeing Military Airplane Co., Seattle, WA
AFWAL-TR-85-2060; 292 p. January 1986.
aircraft engines; fire extinguishment; halon 1202; halon 1301; ventilation; fire extinguishing agents; fire detection; air flow; aircraft compartments; ignition; aircraft fires
Fire tests and extinguishant concentration tests were conducted using a simulated portion of the F-16 aircraft engine compartment in the Aircraft Engine Nacelle (AEN) fire test simulator at WPAFB. Combat damage simulation included outer compartment wall penetration allowing either inflow or outflow of ventilation airflow through an external would and can perforation or engine bleed air line damage. "Standard" fire and agent concentration test techniques were developed. Existing specifications were found to be adequate in terms of quantity of extinguishing agent. Results also indicated that more rapid agent release resulted in more effective use of the agent. Halon 1301 performed significantly better than Halon 1202, contrary to what the available literature indicated. Fires with combat damage inflow simulation added were the most difficult to extinguish because hot surface ignition sources were created soon after the test fire was ignited. For these, the quantity of agent specified would have been adequate only if the agent reached the fire within a few seconds after ignition.

Johnson, A. M.; Roth, A. J.; Moussa, N. A.
Hot Surface Ignition Tests of Aircraft Fluids. Final Report.
May 1987-May 1988.
Boeing Advanced Systems, Seattle, WA
Blazetech Corp., Winchester, MA
AFWAL-TR-88-2101; 233 p. November 1988.
aircraft engines; hydraulic fluids; hot surfaces; ignition; fire tests; ultraviolet detectors
Five fluids commonly found in aircraft engine components, JP-4 and JP-8 fuels, Mil-H-5606 and Mil-H-83282 hydraulic fluids and Mil-L-7808 lubricating oil, were tested in the Aircraft Engine Nacelle Fire Test Simulator (AENFTS) to define their Minimum Hot Surface Ignition Temperature (MHSIT's) when introduced as a spray or stream onto a hot engine bleed duct. The test employed a simple, uncluttered test section and a realistically simulated portion of the F-16 engine compartment. MHSIT's for all but Mil-H-83282 were consistenlyt found to be higher than the fluids autoignition temperature.

Johnston, W. L.

Johnston, W. L.; Cahalane, P. T.
Examination of Fire Safety of Commercial Aircraft Cabins.
Texas A & M Univ., College Station
SAFE Journal, Vol. 15, No. 2, 4-9, Summer 1985.
aircraft compartments; aircraft hazards; aircraft safety; smoke detectors; exit signs; fabric flammability; breathing apparatus; fire extinguishers; halons; commercial aircraft; fire prevention
Numerous suggestions are made to improve aircraft cabin fire safety.

Kennedy, J. F.

Kennedy, J. F.; Thomas, D. R.
Analysis of Fire Incidents in Military Aircraft Hangers: The Computerized Data Base, An Effective Tool.
Air Force Institute of Technology, Wright-Patterson AFB, OH
AFIT-LSSR-17-788; 77 p. September 1978.
Available from National Technical Information Services AD/A-061334
hangars; databases; accident investigations; fire prevention; management information systems; military facilities; fire extinguishers; smoke detectors; warning systems

This thesis analyzes an existing United States Navy computerized data base of fire incidents in aircraft hangars to demonstrate the usefulness of such a data base as a management tool and also the need for a similar data base in the Unites States Air Force. The analysis is accomplished using the Statistical Package for Social Sciences (SPSS) program to perform frequency, crosstabulation and breakdown operations on the data base. The authors concluded that the effective assessment of fire loss potential and the justification of existing or proposed fire protection policy could be greatly enhanced by information on the frequency, causes and behavior of historical fire incidents.

Kourtides, D. A.

Kourtides, D. A.; Parker, J. A.; Hilado, C. J.; Anderson, R. A.; Tustin, E.; Arnold, D. B.; Gaume, J. G.;Binding, A. T.; Mikeska, J. L.
Fire Safety Evaluation of Aircraft Lavatory and Cargo Compartments.
National Aeronautics and Space Admin., Moffett Field, CA
San Francisco Univ., CA
Boeing Commercial Airplane Co., Seattle, WA
McDonnell-Douglas Corp., Long Beach, CA
Journal of Fire and Flammability, Vol. 7, 125-159, January 1976.
NASA TM-X 62471; 56 p. August 1975.
N75-32029
aircraft compartments; animals; containment; aircraft interiors; fire tests; fire load; fire safety; toxicity; plastics; polyethylene; paper; temperature; heat flux; smoke detectors
A program to evaluate containment of fire in aircraft interior spaces, e.g., lavatories and cargo compartments of wide-body jet aircraft, was conducted.

Lucas, D.

Lucas, D.
AH-1W Helicopter System Safety Evaluation of Fire Detection System. Final Report. April 2, 1988-June 24, 1988.
Naval Air Test Center, Patuxent River, MD
NATC-RW-119R-88; 24 p. May 18, 1989.
Available from National Technical Information Services AD/B-133315
helicopters; fire detection systems; systems safety

McGunigle, R. D.

McGuingle, R. D.; Jackson H. W.; Beavers, R. R.
Applicability of Fiber Optics to Aircraft Fire Detection Systems. Final Report. May 15-August 15, 1978.
HTL Industries Inc., Santa Ana, CA
AFAPL-TR-78-84; HTL-K-WEST-D-1530; 73 p. October 1978.
Available from National Technical Information Services AD/A-063974
fiber optics; fire prevention; safety devices; signal detection; aircraft crash equipment; circuits; reliability; ultraviolet radiation; warning systems
A review of the state-of-the-art in ultraviolet conducting fiber optics and related system components was conducted with the objective of evaluating their potential applicability to solar blind, UV fire detection systems. From this basis, conceptual systems were developed and anlyzed to assess the potential payoff of incorporating optical enhancement to improve the performance, and to reduce the initial and life cycle cost, size and weight of such systems, and to effect detector circuit simplification and improvement in system reliability.

McKee, R. G.

McKee, R. G.; Alvares, N. J.
Response of Smoke Detectors to Pyrolysis and Combustion Products From Aircraft Interior Materials.
Stanford Research Inst., Menlo Park, CA
NASA-CR-137949; 55 p. April 1976.
Available from National Technical Information Services N76-32141
aircraft interiors; aircraft compartments; combustion products; warning systems; fire detection; fire resistant materials; interior furnishings; tests; pyrolysis; safety; smoke detectors; finishes (fabrics)
The following projects were completed as part of the effort to develop and test economically feasible fire-resistant materials for interior furnishings of aircraft as well as detectors of incipient fires in passenger and cargo compartments: (1) determination of the sensitivity of various contemporary gas and smoke detectors to pyrolysis and combustion products from materials commonly used in aircraft interiors and from materials that may be used in the future, (2) assessment of the environmental limitations to detector sensitivity and reliability. The tests were conducted on three groups of materials by exposure to the following three sources of exposure: radiant and Meeker burner flame, heated coil, and radiant source only. The first test series used radiant heat the flame exposures on easily obtainable test materials. Next, four materials were selected from the first group and exposed to an incandescent oil to provide the conditions for smoldering combustion. Finally, radiant heat exposures were used on advanced materials that are not readily available.

Miniszewski, K. R.

Miniszewski, K. R.; Waterman, T. E.; Campbell, J. A.; Salzberg, F.
Fire Management/Suppression Systems/Concepts Relating to Aircraft Cabin Fire Safety. Final Report. September 26, 1980-February 28, 1982.
IIT Research Inst., Chicago, IL

Gage-Babcock and Associates, Elmhurst, IL
DOT/FAA/CT-82/134; 154 p. July 1982.
Available from National Technical Information Services
aircraft compartments; fire protection; fire detection; fire suppression; fire safety; postcrash fires; smoke control; fire barriers; evacuation
The purpose of this study was to provide FAA with a comprehensive review of the applicability of fire protection (management/suppression) system (or concept) to aircraft cabin fire safety. Both inflight and postcrast fires were considered. The establishment and documentation of the feasibility of each system/concept, determination of costs and benefits for systems judged feasible, and development of test programs to evaluate systems for unknown (undocumented) feasibility also are included. The study included a literature search to document the course and consequencers of past accidents, and the degree to which various fire protection concepts had been developed. Fire scenarios were developed from accident histories and engineering analysis, and used to assist in judging the potential of the various systems/concepts examined. The study encompassed fire prevention, detection, confinement, and suppression, handing of combustion products, and escape aids.

Payne, G. C.

Payne, G. C.
Aircraft Fire Detection and Suppressant Systems.
Graviner Co., Colnbrook, England
Tech Air, Vol. 33, 2-6, May 1977.
aircraft safety; combustion chambers; Concorde aircraft; fire extinguishers; warning systems; monitors

Rockwell International

Rockwell International
Certification by Analysis of Specification Verification for Smoke Detector System.
Rockwell International, Downey, CA
E089-0639; 69 p. September 1977.
Available from National Technical Information Services AD/B-034295
fire alarm systems; smoke detectors; fire extinguishing agents; bromotrifluoromethane; survival; aircraft fires; fire safety; bromine compounds; fluorine compounds; methane

Shelbourn, E. H.

Shelbourn, E. H.
Improved Smoke Generator for Aircraft Testing.
McDonnell Douglas Corp., Long Beach, CA
Society of Flight Test Engineers. Annual Symposium, 15th.
August 12-16, 1984, St. Louis, MO, 14/1-4 pp, 1984.
smoke generators; aircraft safety; simulation; smoke detectors; heaters
An improved smoke generator is described for on-aircraft testing of smoke detection systems and smoke clearning and peetration rates. A heater is added to an existing smoke generator in order to produce smoke that more realistically simulates real fire conditions. Tests demonstrated significantly earlier detection than with the unmodified generator.

Springer, R. J.

Springer, R. J.; Sheath, P. H.; Robinson, S. P.; Smith, D. J. V.
Advanced Ultra-Violet (UV) Aircraft Fire Detection System.
Volume 1. System Description and Flight Test. Final Report. December 15, 1977-October 26, 1981.
General Dynamics Fort Worth Div., TX
AFWAL-TR-82-2062; 160 p. August 1982.
Available from National Technical Information Services AD/A-121253
aircraft safety; fire detection; ultraviolet radiation; warning systems; nacelle fires; fire detectors; flight tests; reliability
Ultraviolet (UV) radiation technology was utilized to provide advanced means of detecting fire hazards more reliably and more rapidly than current thermal activated continuous cable type systems. The first phase consisted of analysis and design requirements follow by design and fabrication, environmental testing, and flight testing of the system on an F-111 high performance aircraft. The objectives of this program were met. Two ultraviolet (UV) detection systems were developed, fabricated, and test flown. The flight test program demonstrated that the systems have a fire detection reliability and a freedom from flase warnings that are significantly better than existing service equipment. One system, system A, includes a high degree of redundancy such as fuel power supplies, dual sensors, and dual microprocessors along with self-checking and automatic reconfiguration. These features provide a reduction in pilot work load and reduction in unscheduled maintenance actions. The other system, system B, a simplified system, is based on the same design components as system A but only utilizes a single power supply, single sensor and a single microprocessor. Both systems are considered suitable for near-term service applications.

Springer, R. J.; Sheath, P. H.; Robinson, S. P.; Smith, D. J. V.
Advanced Ultra-Violet (UV) Aircraft Fire Detection System. Volume 2. System Hardware Design, and Test. Final Report. December 1977-October 1981.

General Dynamics Fort Worth Div., TX
AFWAL-TR-82-2062; 512 p. December 1981.
Available from National Technical Information Services AD/A-121721
aircraft safety; fires; ultraviolet radiation; warning systems; circuits; computer programs; design analysis; fire hazards; ultraviolet detectors; aircraft fires; aviation safety
The objective of the program was to utilize ultraviolet (UV) radiation technology to provide advanced means of detecting fire hazards more reliably and more rapidly than current thermally activated continuous cable type system. This volume, Volume 2, of three volumes provides detailed information on the development, circuit/software design and qualification testing of the system component.

Springer, R. J.; Sheath, P. H.; Robinson, S. P.; Smith, D. J. V.
Advanced Ultra-Violet (UV) Aircraft Fire Detection System.
Volume 3. Ground Support Equipment (GSE) for System Checkout. Final Report. December 1977-October 1981.
General Dynamics Fort Worth Div., Fort Worth, TX
AFWAL-TR-82-2062; 208 p. August 1982.
Available from National Technical Information Services AD/A-130298, N84-10039
aircraft fires; fire detectors; ultraviolet detectors; fire hazards; ground support equipment; warning systems; ultraviolet radiation; power supplies; flight tests; aircraft hazards
A portable unit is described for automatically checking out a system which uses ultraviolet radiation to detect aircraft fire hazards. The unit reads out sorted data gathered during flight, checks the operational capability of the detector, and identifies faulty line replacement units. Volume 3 (of three volumes) provides detailed information on the Ground Support Equipment (GSE) for automatic and manual checkout of the system.

Zallen, D. M.

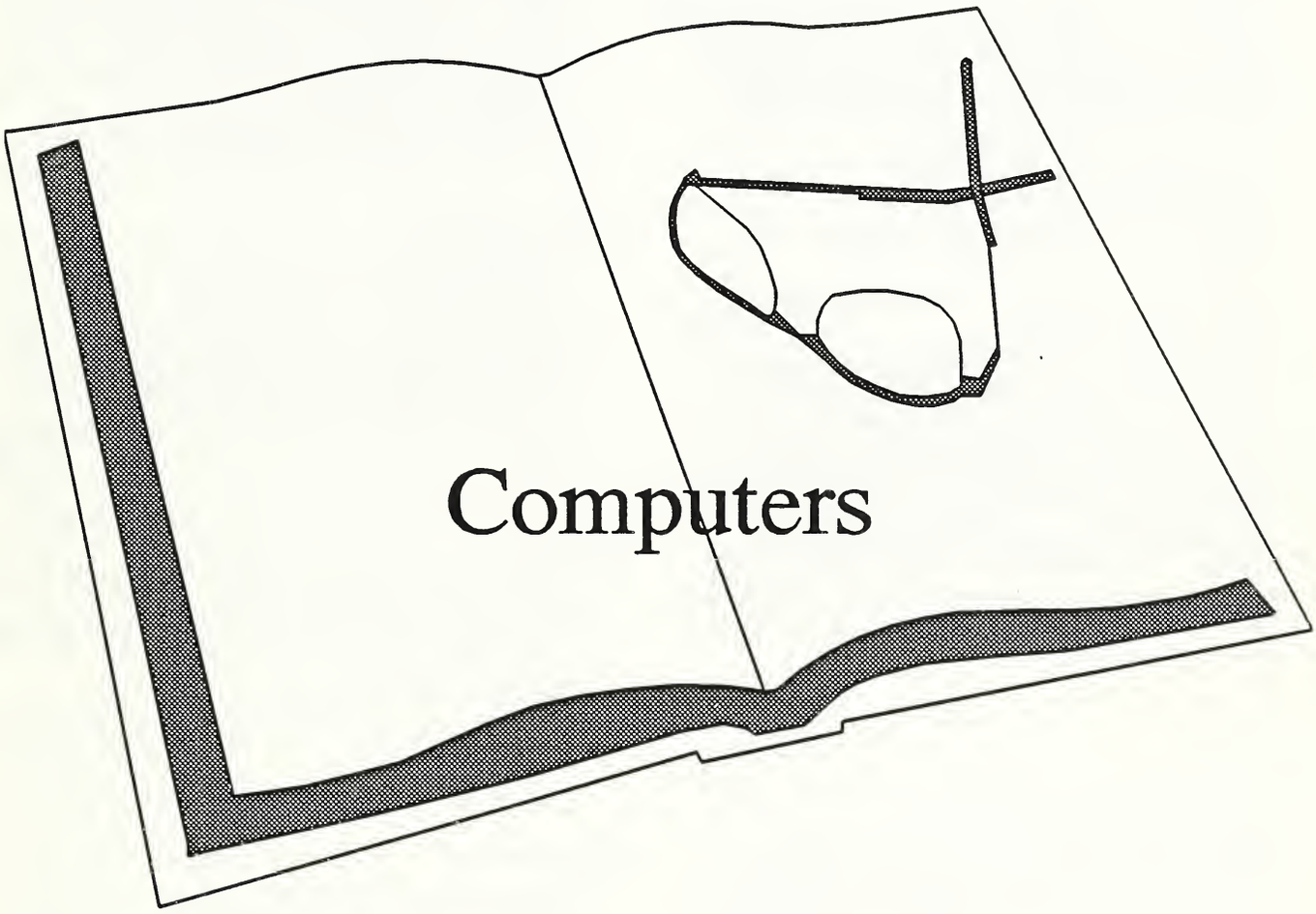
Zallen, D. M.; Morehouse, E. T.; Dees, B. R.; Walker, J. L.; Campbell, P.
Fire Protection System for Hardened Aircraft Shelters. Volume 1 of 3. Discussion and Appendixes A-C. Final Report. October 1984-August 1987.
New Mexico Engineering Research Inst., Albuquerque, NM
ESL-TR-86-13; 323 p. October 1987.
Available from National Technical Information Services AD/A-199715
fire protection; fire extinguishing agents; fire detection; fire suppression; JP-4 jet fuel; halons

Zallen, D. M.; Morehouse, E. T.; Dees, B. R.; Walker, J. L.; Campbell, P.
Fire Protection System for Hardened Aircraft Shelters. Volume 2 of 3. Appendices D-G. Final Report. October 1984-August 1987.
New Mexico Engineering Research Inst., Albuquerque, NM
ESL-TR-86-13; 338 p. October 1987.
Available from National Technical Information Services AD/B-123816
fire protection; fire extinguishing agents; fire detection; fire suppression; JP-4 jet fuel; halons

Zallen, D. M.; Morehouse, E. T.; Dees, B. R.; Walker, J. L.; Campbell, P.
Fire Protection System for Hardened Aircraft Shelters. Volume 3 of 3. Appendix H. Final Report. October 1984-August 1987.
New Mexico Engineering Research Inst., Albuquerque, NM
ESL-TR-86-13; 35 p. October 1987.
Available from National Technical Information Services AD/A-197602
fire protection; fire extinguishing agents; fire detection; fire suppression; JP-4 jet fuel; halons

Zallen, D.M.; Schaub, E.; Graham, M.; Watson, J.
Evaluation of Optical Fire Detectors.
New Mexico Univ., Albuquerque, NM
Instrument Society of Ameria. International Instrumentation Symposium, 34th Proceedings. May 2-6, 1988, Albuquerque, NM, 121-128 pp, 1988.
fire detectors; fire protection; airports; sensors; aircraft hangars

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Bibliography 1975-1990



Computers

Surprisingly, little work has been published on this topic in spite of the tremendous growth in computers over the period. There are a number of review articles [Nelson 1977, Woodcock 1989, Smith 1989, Beaudry 1987, Johnson 1986, Peterson and Schwalbe 1990, and Gibbs 1985], but little testing [Endo 1976] and not much new other than VESDA.

These facts may be related to the decentralization of computing (the rise in personal computers and workstations), and the reduction in power consumption of the hardware requiring less cooling air (resulting in easier detector application) and fewer fires.

Beaudry, J. P.

Beaudry, J. P.; Trujillo, T. M.; Zallen, D. M.; Campbell, P.; Walker, J. L.
Selective Automatic Extinguisher for Computer Cabinets Class A, B, or C With Notification (SAFECOMP). Final Report.
October 1984-February 1986.
New Mexico Univ., Albuquerque
ESL-TR-86-14; NMERI-WA3-5-(3.01); 148 p. July 1986.
Available from National Technical Information Services AD/A-172033
fire extinguishers; fire alarm systems; fire suppression; warning systems; smoke detectors; computers
Currently, fire protection in electronic and computer facilities is provided by full flooding halon or water sprinkler systems. An original, compact, smoke detector automatic extinguisher and alarm unit for local extinguishment of computer or electronic cabinets is described. An acoustic receiver which detects the alarm and provides fire department notification also is described. Environmental, component and system testing is discussed and test data presented.

Endo, K.

Endo, K.
Report on Computer Fire Tests.
Nohmi Bosai Kogyo Co. Ltd., Tokyo, Japan
U. S./Japan Government Cooperative Program on Natural Resources. Panel on Fire Research and Safety. Volume 6. Fire Detection. October 19-22, 1976, Tokyo, Japan, 1-14 pp, 1976.
fire detection; fire research; fire safety; fire tests; computers; smoke detectors; extinguishing; room fires; smoke density

Everett, H. R.

Everett, H. R.; Gilbreath, G. A.
ROBART II: A Robotic Security Testbed.
Interim Report.
October 1987-September 1988.
Naval Ocean Systems Center, San Diego, CA
NOSC/TD-1450; 88 p. January 1989.
Available from National Technical Information Services AD/A-208399
robotics; data processing; detection; humidity

Fire Prevention

Fire Prevention
Computer Suites--Some Guidance on Fire Safety Requirements.
Fire Prevention, No. 113, 13-16, March 1976.
computers; fire safety; construction; fire detection; fire extinguishing systems; storage; paper; cables; cleaning; void spaces

Gibbs, L.

Gibbs, L.; Jenner, R.; Rolf, R.
Recognising Air Flows in Computer Suites When Siting Fire Detectors.
Central Research Lab., Surrey, England
Fire, Vol. 77, No. 963, 31, September 1985.
fire detectors

Hansen, S. L.

Hansen, S. L.
Experience With Software Analysis as a Test Procedure.
Elektronik Centralen, Hoersholm, Denmark
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '89", 9th. September 26-28, 1989, Duisburg, West Germany, Luck, H., Editor, 703-714 pp, 1989.
fire detection; computer programs; tests; fire alarm systems; safety; reliability

Johnson, P. F.

Johnson, P. F.
Fire Detection in Computer Facilities.
Central Investigation and Research Lab., Melbourne, Australia
Fire Technology, Vol. 22, No. 1, 14-32, February 1986.
computers; fire loss; fire protection; smoke detectors; spacing; smoldering; sampling

Johnson, P. F.
Very Early Smoke Detection for Computer and Telecommunications Industries.
Federal Department of Housing and Construction, Melbourne, Australia
Fire Safety Journal, Vol. 14, 13-24, 1988.
Society of Fire Protection Engineers. Fire Detection and Suppression...Today's Technology. March 9-11, 1987, Linthicum Heights, MD, 1-21 pp, 1988.
computers; communication networks; fire detectors; mechanisms; false alarms; fire damage; fire spread; fire models; combustion; fire plumes
The tremendous changes in digital electronic technology have changed the look of computer centres, telephone exchanges, control rooms and other facilities.

Logan, E. A.

Logan, E. A.
Fire Detection Systems in Computer Rooms - Will they Detect Fires?
Fire Prevention, No. 178, 15-17, April 1985.
computers; fire alarms systems

Nelson, H. T.

Nelson, H. T.
Fire Protection for Essential Electronic Data Processing Facilities.
Reed Shaw Stenhouse, Inc., CA
Fireline, 5-7,9, February/March 1977.
automatic data processing; fire protection; facilities; construction; fire detection; fire protection; sprinkler systems

Peterson, D.

Peterson, D.; Schwalbe, K.
Preventing Fire Disasters in Computer Rooms.
CUH2A, Princeton, NJ
Consulting/Specifying Engineer, Vol. 8, No. 3, 96-98,100,102, September 1990.
computers; fire prevention; room fires; fire protection; halon 1301; halons; discharge pressure

Prossdorf, T.

Prossdorf, T.; Kainz, D.; Hofling, B.
Brand- und Loschversuche an EDV-Anlagen.
[Fire and Extinguishment Experiment of an EDV (Electronic Computer/Equipment) Enclosure.]
Allianz Brandschutz Service, Munchen, West Germany
TELA-Versicherung, Munchen, West Germany
SD 6; 1987.
In: German
computers; halons; sprinklers; fire losses; fire tests; carbon dioxide; fire extinguishers; fire suppression

Smith, G.

Smith, G.
Computer Protection. Is BS 6266:1982 Alive and Well?
Consultant, Britannia Fire Ltd.
Fire Surveyor, Vol. 18, No. 1, 18-24, February 1989.
computers; fire detection; fire protection

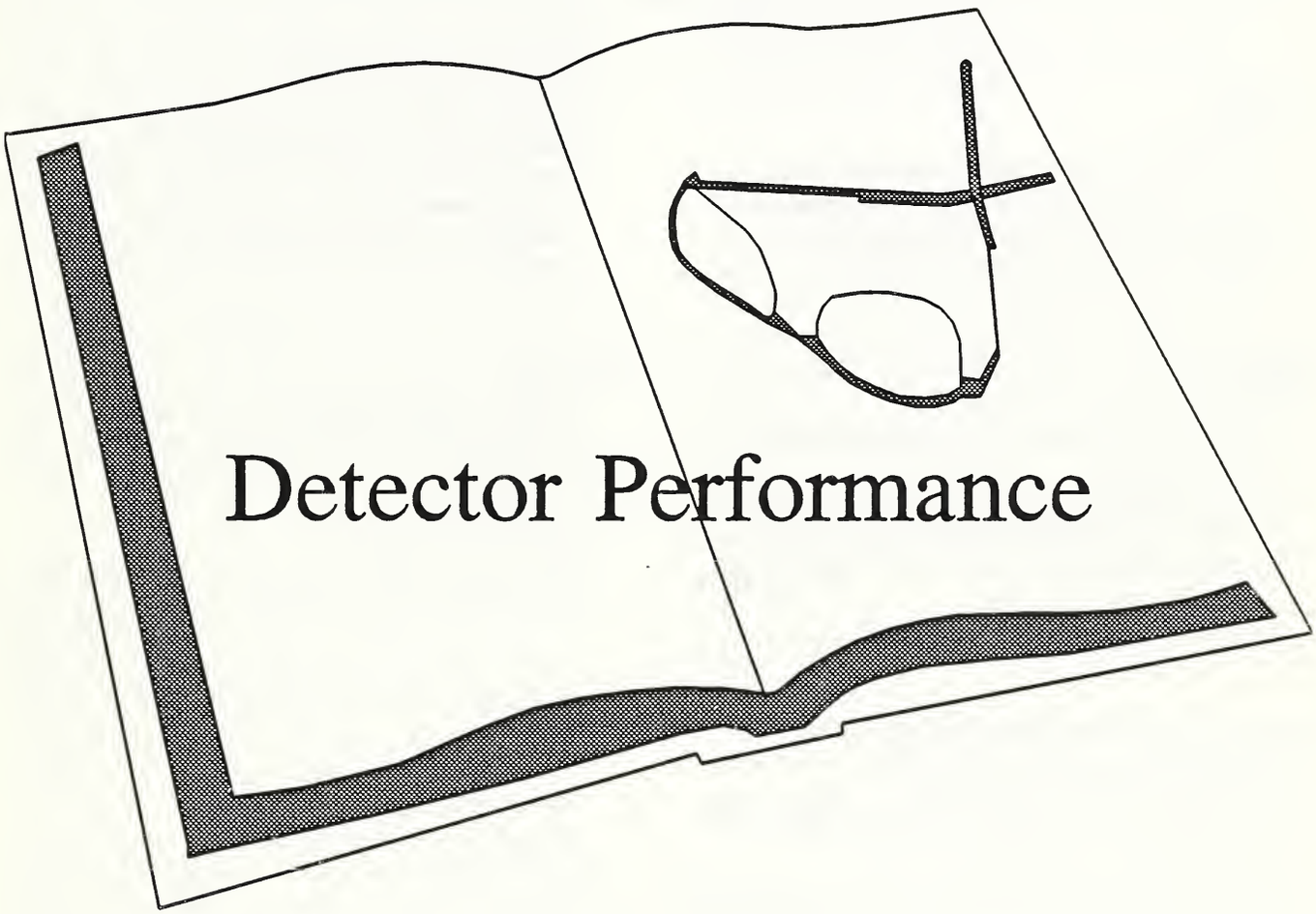
Transue, R. E.

Transue, R. E.; Hall, C.
Fire Safety and Electronics.
Rolf Jensen & Assoc., Deerfield, IL
Pyrotronics, Cedar Knolls, NJ
Specifying Engineer, Vol. 49, No. 5, 92-94, May 1983.
fire safety; electronics; fire protection; decision making; computers

Woodcock, J.

Woodcock, J.
Current Concepts in Computer Protection.
Sedgwick Risk Control Services, England
Fire Surveyor, Vol. 18, No. 3, 4-8, June 1989.
computers; risk analysis; fire protection; management; sprinklers; halons; carbon dioxide; high expansion foams; fire detection

International Fire Detection
Bibliography 1975-1990



Detector Performance

This was by far the largest category into which many general papers were placed. The general reaction to the contents of this section is disappointing. Much of the work is older and well understood. Little of the newer work is innovative, indicating the general lack of interest internationally on exploring detector performance. Few tests have been conducted in the past decade, and many papers, while discussing problems, suggest no solutions.

One interesting technical paper [Ellwood 1989] deals with analog/optical heat detection and another well written paper discusses flame detectors [Middleton 1989]. There are state-of-the-art papers on numerical modeling of detector response [Vannerberg 1988, Horiuchi 1990, Mowrer 1990 and Beaver 1990] and two on beam detectors [Shalna 1988 and Packham *et al* 1981] which are worthy of examination. One Japanese paper [Takahashi 1990] deals with the effects of ceiling height on the response of analog rate of rise thermal detectors which use *fuzzy logic* decision algorithms.

Alliance

Alliance
Putting Fire In Its Place. Important New Reasons to Consider a Fire Management System.
Alliance, Vol. 1, 14-15, Spring 1988.
management; safety; fire detection systems

Alpert, R. L.

Alpert, R. L.
Review of Recent Work on Fire Detection and Extinguishment.
Factory Mutual Research Corp., Norwood, MA
UJNR Panel on Fire Research and Safety. 8th Joint Panel Meeting. May 13-21, 1985., Tsukuba, Japan, 808-812 pp, 1985.
fire detection; fire extinguishment; fire suppression

Association for French Standards

Association for French Standards
Fire Detection Material--Detectors, Signal Panels and Intermediary Devices.
Job 211-2-fr; 53 p. July 25, 1978.
fire detectors; standards; design applications; construction; fire detection systems; tests

Atomic Energy Control Board

Atomic Energy Control Board
Ionization Chamber Smoke Detectors. Questions and Answers.
Atomic Energy Control Board, Ottawa, Canada
INFO-0263; 24 p. March 1988.
Available from National Technical Information Services INFO-0263
ionization detectors; smoke detectors; safety

One kind of smoke detector, the ionization-type, is regulated by the Atomic Energy Control Board (AECB) because it uses a radioactive substance in its mechanism. Radioactivity and radiation are natural phenomena, but they are not very familiar to the average householder. This has led to a number of questions being asked of the AECB. These questions and AECB responses are outlined.

Badr, O.

Badr, O.; Grubelich, M.
Electronic Sensor for Flame Speed Measurements.
Lehigh Univ.
Eastman Kodak Co.
ISA Transactions, Vol. 23, No. 2, 39-43, 1984.
sensors; flame speed; electronics; flame propagation

Barr, L. G.

Barr, L. G.
Early Warning Hazard Detection.
Brunswick Corp.
Fireline, 8-10, August 1976.
warning systems; fire detectors; sensors; smoke detectors

Beever, P. F.

Beever, P. F.
Estimating the Response of Thermal Detectors.
Arup Research and Development, London, England
Journal of Fire Protection Engineering, Vol. 2, No. 1, 11-24, 1990.
heat detectors; sprinklers; temperature; thermal response; heat loss; radiative heat transfer; latent heat; rate of rise detectors; test methods

Belanger, R.

Belanger, R.; Buckley, D. W.; Swenson, J. B.
Enviornmental Assessment of Ionization Chamber Smoke Detectors Containing Am-241. Technical Report.
January-October 1979.
Science Applications, Inc., La Jolla, CA
NUREG/CR-1156; 173 p. November 1979.
Available from National Technical Information Services NUREG/CR-1156
ionization chambers; isotopes; fire detection systems; radiation hazards; fire safety; smoke detectors; radioactive materials
The NRC is reevaluating the adequacy of existing policy dealing with radioactive materials. One such consumer product is the ionization chamber smoke detector (ICSD), which in recent years has become widely distributed. This report is the assessment of the impact of ICSD's on people and the assessment of the impact of ICSD's on people and the enviornment. Its benefits and risks are evaluated for presently-distributed ICSD's against alternatives. The work is intended to be a source of information for a generic environmental impact statement on consumer products containing radioactive material which will be written in the future. The report concludes that the sum of diseases to the population from the annual production, distribution, use, and disposal of 14 million Am-241 ICSD's is much lower than that which could potentially result in one cancer death. The use of Am-241 ICSD's is justifiable as a means to prevent loss of life and property. The estimated benefit-to-risk ratio is more than 15,000.

Bengtson, S.

Bengtson, S.
Effect of Different Protection Measures With Regard to Fire-Damage and Personal Safety.
Swedish Fire Protection Assoc., Stockholm, Sweden
FoU-brand, Vol. 1, 13-20, 1978.
Conseil International du Batiment (CIB). Fire Safety in Buildings: Needs and Criteria. Final Report. Proceedings June 2-3, 1977, Amsterdam, Holland, CIB Publication 48, 153-177 pp, 1977.
fire safety; fire damage; fire detection; ventilation; fire departments; sprinklers; escape means; safety; sprinkler systems; planning

Bengtson, S.; Laufke, H.
Methods of Estimation of Fire Frequencies, Personal Safety and Fire Damage.
Swedish Fire Protection Assoc., Stockholm, Sweden
Fire Safety Journal, Vol. 2, No. 3, 167-180, 1979/1980.
fire damage; fire detectors; sprinklers; fire departments; evacuation; fire spread

Benjamin, I. A.

Benjamin, I. A.
Detection in U.S.A., 1979-1980.
National Bureau of Standards, Gaithersburg, MD
U.S./Japan Cooperative Program in Natural Resources. Fire Research and Safety. 5th Joint Panel Meeting. October 15-24, 1980, Gaithersburg, MD, NBS SP 639, Chidester, J. E., Editor, 22-25 pp, 1982.
Available from Government Printing Office
smoke detectors; fire detectors

Benjamin, I. A.
Detector Response in Large Buildings.
National Bureau of Standards, Gaithersburg, MD
Society for Fire Protection Engineers and the National Bureau of Standards. Engineering Applications of Fire Technology Workshop Proceedings. April 16-18, 1980, National Bureau of Standards, Gaithersburg, MD, Society of Fire Protection Engineers, Boston, MA, Nelson, H. E., Editor, 1-24 pp, 1983.
buildings; detectors; fire detectors; response time
The purpose of this paper is to provide some background on the latest information in designing for the use of detectors.

Berry, C. H.

Berry, C. H.
Will Your Smoke Detector Wake You?
Department of the Navy, Washington, DC
Fire Journal, Vol. 72, No. 4, 105-108, July 1978.
smoke detectors; wakefulness

Bineau, H.

Bineau, H.
Means of Fire Protection in Buildings--Sprinklers, CO2, Halons--Study of Similarities.
Centre National de Prevention et de Protection, Paris, France
Commission of the European Communities. Fires in Buildings. September 18-21, 1984, Luxembourg, Elsevier Applied Science Publishers, NY, Mourareau, R. and Thomas, M., Editor, 342-340 pp, 1985.
fire protection; sprinklers; carbon dioxide; halons; fire extinguishers; smoke detectors; heat detectors

Borrelli, F. J.

Borrelli, F. J.
Comparative Analysis of Fire Protection Engineering
Education at the University of Maryland and the Higher Fire Academy of Moscow. Maryland Univ., College Park
ENFP 416; 53 p. December 12, 1989.
education; fire protection engineering; fire detection systems; extinguishing; flammability; life safety; hazard analysis; heat transfer; thermodynamics; fire protection

Bricker, R. W.

Bricker, R. W.
Test Results from a Comparative Evaluation of a Condensation Nuclei Fire Detector.
Webb, Murray and Associates, Inc., Houston, TX
NASA CR-3874; 62 p. March 1985.
fire prevention; safety devices; photoelectric detectors; smoldering; plastics; ionization detectors; warning systems
A series of 138 tests was conducted to compare the fire/smoke alarm response of a Condensation Nuclei Fire Detector (CNFD) with photelectric and ionization detectors. Tests were conducted in a former control room 8.5 m (28 ft) by 8.9 m (29 ft 2 in) with a 2.7 m (9 ft) ceiling. The room had air supplied from above the ceiling and under the floor with return air exiting from ceiling grills. The environment was varied from 278 to 305 K (40 to 90 deg. F) and relative humidities from 8 to 65 percent. Four detection zones were located in the room. Each zone contained a sampling head for the CNFD, a photodetector, and an ionization detector so that each detector system had four opportunities to alarm during tests. The particle level in the test room was also monitored during tests with a condensation nuclei particle counter. The CNFD responded to 90 percent of exposures to smoldering plastic and 84 percent of exposures to visible fire. The photoelectric response was 43 and 12.5 percent respectively for the same conditions. The ionization response was 9 and 48 percent respectively.

Bridge, N. W.

Bridge, N. W.
Some Monitoring Circuits for Multi-Zone Line Detector Systems.
Building Research Association of New Zealand, Wellington, New Zealand
Fire Prevention Science and Technology, No. 18, 21-26, December 1977.
line detectors; fire protection; sprinkler systems; pallet storage; valves; extinction; cables; monitors; circuits

Bright, R. G.

Bright, R. G.
A New Test Method for Automatic Fire Detection Devices.
National Bureau of Standards, Gaithersburg, MD
Fire Technology, Vol. 13, No. 2, 105-113, May 1977.
NBSIR 76-1172; 28 p. December 1976.
Available from National Technical Information Services PB-261217
fire detectors; fire detection; test methods
An analysis of the test methods for automatic fire detection devices in the USA reveals the fact that different types and different sizes of fires are used to evaluate different classes of detectors. The result is a lack of comparison test data for each detector class and, as a consequence, intelligent decisions cannot be made in the selection of automatic fire detectors for specific fire risks. A new test method is proposed in which all automatic fire detectors, regardless of sensor type, would be subjected to a series of the same test fires. In addition, each test fire series would consist of three different test fire sizes. From the results obtained, it should then be possible to match a detector's characteristics against a specific fire risk resulting in a more intelligent application of automatic fire detectors.

Bright, R. G.
Detection of Fire Involving Electric Cable Materials.
National Bureau of Standards, Gaithersburg, MD
National Academy of Sciences-National Research Council.
Flammability, Smoke, Toxicity, and Corrosive Gases of Electric Cable Materials. Report of the Task Force. NMAB-342, Washington, DC, 51-69 pp, 1978.
fire alarm systems; electrical cables; detection; cables
A competent fire alarm system is a key part of an overall fire protection scheme for protection of people and property. This presentation will deal specifically with the automatic detection of fire with special emphasis on the detection of fires involving electric cable materials.

Bryant, P.

Bryant, P.
Building Management Systems and Standardization.
Loss Prevention Council, UK
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '89", 9th. September 26-28, 1989, Duisburg, West Germany, Luck, H., Editor, 547-554 pp, 1989.
fire detection; building management; standardization

Budnick, E. K.

Budnick, E. K.
Fire Spread Along a Mobile Home Corridor. Interim Report.
National Bureau of Standards, Gaithersburg, MD
NBSIR 76-1021; 56 p. July 1976.
Available from National Technical Information Services PB-257101

corridor tests; interior finishes; intumescent coatings; life safety; mobile homes; smoke detectors; surface flame spread

A series of tests was conducted in the corridor area of a typically constructed mobile home. These tests were designed to: (1) evaluate the performance of a variety of combinations of wall and ceiling materials as a result of exposure to a typical ignition in a full-scale mobile home corrridor, and (2) determine the relationship between full-scale tests and laboratory flammability tests, particularly the ASTM E-84 tunnel test, a measure of surface flame spread. The tests were restricted to one set of conditions in which the living room at the end of the corridor was exposed to a fire resulting from ignition of a standardized 6.4-kg (14-lb) wood crib. Nine tests were conducted with seven different combinations of wall and ceiling materials. Performance of the various combination of wall and ceiling materials was examined based on the time to reach untenable conditions in the corridor. Measurements utilized in evaluating levels of tenability included gas temperatures, surface temperatures, irradiance, concentrations of oxygen and carbon monoxide, and smoke densities. Under this set of test conditions, it was found that the extent of fire spread and the time to reach untenable conditions are significantly influenced by the surface flame spread characteristics of the wall and ceiling finish materials in the corridor. For a mobile home corridor with conventional wall and ceiling linings (ASTM E-84:FSC= 200max), untenable conditions were reached in the corridor in less than four minutes. With class A (FSC = 25 max) wall and ceiling materials in the corridor, untenable conditions were not reached.

Bukowski, R. W.

Bukowski, R. W.
Detection of Fires in Electrical Cables.
National Bureau of Standards, Gaithersburg, MD
National Academy of Sciences-National Research Council, Flammability, Smoke, Toxicity, and Corrosive Gases of Electric Cable Materials. Report of the Task Force, Washington, DC.
139-142 pp, NMAB-342, 1978.

electrical cables; fire alarm systems; extinguishing; fire detection; electrical insulation; combustion products; fire extinguishers; systems engineering

The intelligent application of a system design approach is necessary to provide the level of detection performance required at a cost consistent with the risk involved. Each and every type of detector and system available has applications where it and it alone is the best. The selection of detector and system arrangement must be determined through a logical decision process. This process should always involve a qualified fire protection engineer or system design who is familiar with all types of detection equipment and the ways of which each works the best.

Bukowski, R. W.
Fire Protection Systems for Rail Transportation of Class A Explosives. Interim Report.
National Bureau of Standards, Gaithersburg, MD
NBSIR 80-2170; 30 p. November 1980.
Available from National Technical Information Services PB81-153975

bombs (ordnance); computer models; fire detection systems; fire suppression; large scale fire tests; heat transfer; railroad accidents; small scale fire tests; thermal protection

As a result of several accidents involving fire induced detonation of military explosive during rail shipment, a research project, funded by the Federal Railroad Administration (FRA), was initiated at the Center for Fire Research (CFR) at the National Bureau of Standards (NBS). This project was initiated to evaluate various methods of protection of Class A explosives from fire, and to identify one or more cost-effective approaches which could be explored in greater detail in later studies. Active systems (detection, notification, and extinguishment) and passive systems (thermal insulating barriers) were evaluated regarding cost, feasibility and level of protection provided for the major hazard scenarios involved in rail shipment of explosives. The passive, thermal barrier approach was selected as the most reliable and less costly of the options studied while providing an acceptable level of protection. Small-scale and full-scale tests were conducted to obtain performance data on one specific thermal barrier material. Based on this data, a computer model was developed which can predict temperatures of the boxcar floor, top surface temperature of a thermal barrier, and casing/explosive interface temperature of a wood-pallet mounted bomb for a range of fire sizes. The model predications compare favorably with measured results from a limited number of experiments. Further experimental data are needed to refine the model and establish an acceptable confidence level in the predicted values. The proposed work necessary to provide this refinement and verification is described.

Bukowski, R. W.; Mulholland, G. W.
Smoke Detector Design and Smoke Properties. Final Report.
National Bureau of Standards, Gaithersburg, MD
NBS TN 973; 51 p. November 1978.
National Bureau of Standards. Fire Research and Safety. 3rd Joint Panel Proceedings Conference of the U.S. Japan Cooperative Program in Natural Resources. March 13-17,

1978, Gaithersburg, MD, National Bureau of Standards, Sherald, M. A., Editor, 1-45 pp, 1979. Available from Government Printing Office
aerosol generators; fire detectors; ionization detectors; light scattering detectors; particle size distribution; smoke; smoke detectors
The importance of a reference photometer and reference ionization detector in improving the reliability of smoke detectors is discussed. Recent developments in smoke detector technology are highlighted and theoretical as well as practical experience in regard to detector performance is summarized. Comparison of the theoretically predicted resonse of smoke detectors as a function of particle size with measured values is given. A monodisperse aerosol generator, and electrical aerosol analyzer with a size sensitivity from 0.01 to 1 mu m, and an optical particle counter are described. The size distribution, mass and number concentration, optical density, and coagulation frequency for smoke from burning heptane and smoldering cotton lamp wich are presented. It is shown that a Junge type size distribution provides a good fit to the measured size distribution for both fresh and aged smoke.

Burry, P.

Burry, P.
Fire Detection Research: Some Progress, Problems, and Pointers to the Future.
Fire Research Station, Borehamwood, England
Fire, Vol. 80, No. 989, 13-14, November 1987.
fire detection; fire research

Burry, P.
Principles of Fire Detection. Optical Smoke Detectors.
Fire Research Station, Borehamwood, England
Fire Surveyor, Vol. 14, No. 6, 18-22, December 1985.
smoke detectors

Burry, P.
Principles of Fire Detection. Part 1. Introduction.
Fire Research Station, Borehamwood, England
Fire Surveyor, Vol. 9, No. 4, 46-53, August 1980.
heat detection; heat detectors; fire detection

Burry, P.
Principles of Fire Detection. Part 3. Ionisation Chamber Smoke Detectors.
Fire Research Station, Borehamwood, England
Fire Surveyor, Vol. 11, No. 2, 13-20, April 1982.
smoke detectors; fire detectors; ionization chamber detectors

Burry, P. E.

Burry, P. E.
Improving Methods of Detection.
Fireline, Vol. 2, No. 6, 13, November/December 1977 AND Fire Research Abstracts and Reviews, Vol. 18, Nos. 1-3, 69-70, 1976,
fire detection systems; costs; installation

Capper, R.

Capper, R.
Search for Safety in the North Sea.
Mather and Platt, Ltd., England
Fire Engineers Journal, Vol. 40, No. 119, 9-12, September 1980.
offshore platforms; fire safety; fire detection systems

Chapman, E. F.

Chapman, E. F.
Smoke Detector Selection and Use.
New York Fire Dept.
Fire Engineering, Vol. 131, No. 10, 54-55, October 1978.
smoke detectors; fire prevention; fire protection

Clark, B. A.

Clark, B. A.
Systems Analysis of the Smoke Detector Concept.
National Fire Academy, Emmitsburgh, MD
Fire Chief Magazine, Vol. 24, No. 9, 36-39, September 1980.
smoke detection; systems analysis; fire losses

Colligan, D.

Colligan, D.
Detecting the Fire Detectors.
Firehouse, Vol. 2, No. 2, 16,19, February 1977.
fire detectors; smoke detectors; heat detectors; flame detectors; fire science

Consumer Reports

Consumer Reports
Smoke Detectors.
Consumer Reports, Vol. 45, No. 8, 475-479, October 1980.
smoke detectors

Crane, C. R.

Crane, C. R.; Sanders, D. C.; Endecott, B. R.; Abbott, J. K.
Electrical Insulation Fire Characteristics. Volume 2. Toxicity. Final Report. July 1976-July 1978.
FAA Civil Aeromedical Inst., Oklahoma City, OK
UMTA-MA-06-0025-79-2; 102 p. December 1978.
Available from National Technical Information Services PB-294841
toxicity; electrical insulation; combustion; fire prevention; flammability; inhalation toxicity; pyrolysis products; smoke; smoke detectors; animals; thermal degradation

Crook, J.

Crook, J.
Have a Safe Voyage?
Fire Prevention, No. 233, 18-20, October 1990.
ships; safety; tanker ships; disasters; death

Dardis, R.

Dardis, R.; Thompson, R.
Analyzing the Effectiveness of Alternative Fire Protection Strategies.
Maryland Univ., College Park
Fire Journal, Vol. 73, No. 5, 27-30, September 1979.
fire protection; fire safety; cost benefit analysis; smoke detectors

Daws, S.

Daws, S.
'Intelligent' Approach to Fire Protection.
Electrical Review, Vol. 215, No. 17, 27-28, 1984.
fire protection; false alarms; fire detection systems

Delichatsios, M. A.

Delichatsios, M. A.
Categorization of Cable Flammability Detection of Smoldering and Flaming Cable Fires. Interim Report.
Factory Mutual Research Corp., Norwood, MA
81 p. November 1980.
Available from National Technical Information Services EPRI-NP-1630
cables; flammability; smoldering; fire detection systems

Denney, E. J.

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Fire Safety--Managing Change. Buying the Best in Fire Safety Hardware.
Loss Prevention Council, London, England
Fire Prevention, No. 214, 20-21, November 1988.
fire safety; regulations; standards; fire alarm systems; fire detection systems

Detriche, P.

Detriche, P.; Abdallah, B. M.
Influence de la compatibilite et de situation de sauvegarde sur la securited'un systeme de protection d'incendie associe a un systeme de gestion centralise de batiment. [Influence of the compatibility and on the security of a fire protection system associated with a centralized building management system]
Sicli Systemes Securite S.N.C., Le Blanc Mesnil, France Universite de Technologie de Compiegne, France
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '89", 9th.September 26-28, 1989, Duisburg, West Germany, Luck, H., Editor, 575-593 pp, 1989.
In: French
fire detection

Egan, M. D.

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Concepts in Building Firesafety
Clemson Univ., SC, Robert Krieger Publishing Co., Malabar, FL, 282 p., 1986.
fire safety; fire prevention; fire suppression; building design; planning; building materials; building construction; fire detection; smoke vents; escape means; refuge; high rise buildings

Egyptian Standards Information Service (ESIS)

Egyptian Standards Information Service (ESIS)
Points of View by Developing a Scattering Light Measuring Device.
11 p. September 1980.
light scattering detectors; smoke detectors

Erwin, J. M.

Erwin, J. M.
Is Your Detector Working?
Hurst Fire Dept., TX
Fire Command, Vol. 46, No. 12, 19, December 1979.
smoke detectors; installation; fire departments

Evans, D. D.

Evans, D. D.; Stroup, D. W.
Methods to Calculate the Response Time of Heat and Smoke Detectors Installed Below Large Unobstructed Ceilings.
National Bureau of Standards, Gaithersburg, MD
Fire Technology, Vol. 22, No. 1, 54-65, February 1986.
NBSIR 85-3167; 49 p. July 1985.
Available from National Technical Information Services PB86-105996
ceilings; computer programs; egress; escape; fire alarm systems; fire detection; fire suppression; heat detectors; smoke detectors; sprinkler systems; NFPA 72E
Recently developed methods to calculate the time required for ceiling mounted heat and smoke detectors to respond to growing fires are reviewed. A computer program that calculates activation times for both fixed temperature and rate of rise heat detectors in response to fires that increase in heat release rate proportionally with the square of time from ignition is given. This program produces nearly equivalent results to the tables published in Appendix C, Guide for Automatic Fire Detector Spacing, (NFPA 72E, 1984). A separate method and corresponding program are provided to calculate response time for fires having arbitrary heat release rate histories. This method is based on quasi-steady ceiling layer gas flow assumptions. Assuming a constant proportionality between smoke and heat released from burning materials, a method is described to calculate smoke detector response time, modeling the smoke detector as a low temperature heat detector in either of the two response time models.

Fire

Fire
New Code for Installing and Servicing Detectors and Alarms.
Fire, Vol. 72, No. 897, 514, March 1980.
fire alarm systems; fire detection; fire codes; services; installing

Fire
Why Fire Trade Association Did Not Like the New Smoke Detector Testing Unit.
Fire, Vol. 72, No. 889, 72, July 1979.
smoke detectors; tests; warehouses; storage

Fire Chief Magazine

Fire Chief Magazine
USFA Conference Probes Life Safety.
Fire Chief Magazine, Vol. 22, No. 12, 50-52,54, December 1978.
life safety; human behavior; fire detection; fire suppression; fire protection

Fire Journal

Fire Journal
Fire Alarm Protective Signaling Systems--Manufacturers and Equipment.
Fire Journal, Vol. 81, No. 6, 43-45,47-51,53, November/December 1987.
fire alarm systems; fire detectors; signals; manufacturing

Fire Prevention

Fire Prevention
How Ilford Ltd. Control Risks From Hazardous Materials.
Fire Prevention, No. 120, 19-22, August 1977.
hazardous materials; risk management; photography; flammable liquids; fire fighting; fire fighters; fire detection systems; training

Fire Prevention
Keeping Fire Under Control at Ind Coope.
Fire Prevention, No. 198, 15-18, April 1987.
fire prevention; fire detection systems; fire alarm systems

Fire Prevention
Radiation Exposure From Ionization Smoke Detectors.
Fire Prevention, No. 120, 29, August 1977.
smoke detectors; ionization detectors; exposure; radiation detectors; radiation hazards

Fire Surveyor

Fire Surveyor
Fire Detection in Ducts.
Fire Surveyor, Vol. 8, No. 1, 29-33, February 1979.
ducts; fire detection; fire detectors; smoke detectors; installation

Fissan, H. J.

Fissan, H. J.; Helsper, C.
Zur Reaktion von Rauchdetektoren auf Brandkenngrossen.
[Response of Smoke Detectors from Large Fires.]
Duisburg Univ., West Germany
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '82", 8th. Probleme der automatischen brandentdeckung. October 5-7, 1982, Duisburg, West Germany, Luck, H., Editor, 20-37 pp, 1982.
In: German
smoke detectors

Gage-Babcock and Associates, Inc.

Gage-Babcock and Associates, Inc.
Fire Protection Engineering Survey of Air Traffic Control Towers. Final Report.
Gage-Babcock and Assoc., Inc., Long Beach, CA
Federal Aviation Admin., Washington, DC
Report 7664; 203 p. January 1977.
Available from National Technical Information Services AD/A-111420
control rooms; structures; fire safety; fire protection engineering

Gaylor, W. W.

Gaylor, W. W.
Fire Detection Devices: How They Work, How To Use Them.
Burns and Roe, Inc.
Manhattan College. Design, Construction and Maintenance of Fire-Safe Structures. Volume 2. 1st Annual Fire Engineering Conf. June 6-7, 1983, Manhattan College, Riverdale, NY, Spinna, R. J., Saukin, W. P. and Spinna, R. J., Jr., Editor, 1-17 pp, 1983.
fire detection; fire protection; gas detectors; smoke detection; heat detection; flame detectors

Graham, C. L.

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Radiation Dose Rates From Various Smoke Detectors.
Lawrence Livermore Lab., CA
Fire Journal, Vol. 72, No. 4, 109, July 1978.
smoke detectors; radioactive materials; ionization detectors

Gray, W. G.

Gray, W. G.
Fire Sprinklers vs Smoke Detectors: A Response.
University City Science Center
Fire Control Digest, Vol. 14, No. 3, 1,4-5, March 1988.
sprinklers; smoke detectors

Grow, D. P.

Grow, D. P.
Methodology Investigation of Automatic Fire Suppression Testing in Combat Vehicles. Final Report.
Army Combat Systems Test Activity, Aberdeen Proving Ground, MD
USACSTA-6783; 50 p. March 1989.
Available from National Technical Information Services AD/B-135400
fire suppression; fire detectors; fire detection; fire extinguishers; methodology; fire tests; hydrocarbons

Hale, A. R.

Hale, A. R.; Glendon, A. I.
Delft University of Technology, The Netherlands
Aston Univ., Birmingham, UK
Individual Behavior in the Control of Danger. Industrial Safety Series, 2, Elsevier, New York, 477 p., 1987.
hazards; human behavior; safety

Hampartsoumian, E.

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Principles and Applications of Fiber Optic Sensors for Process Instrumentation and Control.
Leeds Univ., England
Journal of the Institute of Energy, Vol. 59, No. 437, 159-168, 1985.
sensors; fiber optics; instruments; cables; temperature; pressure; flow measurement; concentration measurement

Handa, T.

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Performance Characteristic of Fire Detector and Development of Multi Elements Detectors.
Science University of Tokyo, Japan
U. S./Japan Government Cooperative Program on Natural Resources. Panel on Fire Research and Safety. Volume 6.

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fire detection; fire research; fire safety; false alarms; performance evaluation; sensitivity

Harris, F.

Harris, F.
Problems of the Fire Prevention Officer in Assessing the Need for Automatic Fire Detection.
Essex Fire Dept., England
Fire Service Technical College. Automatic Fire Detection in Non-Domestic Residential Premises. Technical Study. Paper 7. April 3-5, 1978, Gloucestershire, England, 60-61 pp, 1978.
fire detection; fire prevention

Hart, A. R.

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Why Do We Need Automatic Fire Detection?
Fire Service Technical College, Goucestershire, England
Fire Service Technical College. Automatic Fire Detection in Non-Domestic Residential Premises. Technical Study. Paper 1. April 3-5, 1978, Gloucestershire, England, 1-6 pp, 1978.
fire detectors; fire detection

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Fire Detection--The First Stage in Fire-Fighting.
Siemens AG, Munich, West Germany
Commission of the European Communities. Fires in Buildings.
September 18-21, 1984, Luxembourg, Elsevier Applied Science Publishers, NY, Mourareau, R. and Thomas, M., Editors, 94-98 pp, 1985.
fire fighting; fire safety; buildings; fire alarm systems; extinguishment; suppression

Hemme, F.
Measuring the Effectiveness of Automatic Fire Detection Systems.
Fire International, Vol. 90, 45-47, December/January 1984/1985.
fire detection systems

Holland, K. L.

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Ionization Detectors--How Effective Are They?
Chief Inspector of Fire Services
Fire, Vol. 70, No. 875, 612-613, May 1978.
ionization detectors; effectiveness

Horiuchi, S.

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Studies on Fire Modeling in Small Structures.
4 p. 1990.
In: Japanese (Abstract in English)
fire models
A former model was supplemented with a function which measures smoke density of the hot gas layer. It was possible to calculate radiant heat spread in the hot gas layer. However, there were some discrepancies between calculations and actual test results.

Hotta, H.

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Detection of Smoldering Fire in Electrical Equipment With High Internal Air Flow.
Nohmi Bosai Kogyo Co., Ltd., Tokyo, Japan
International Association for Fire Safety Science. Fire Safety Science. Proceedings. 1st International Symposium.
October 7-11, 1985, Gaithersburg, MD, Hemisphere Publishing Corp., NY, Grant, C. E. and Pagni, P. J., Editors, 699-708 pp, 1986.
smoke detectors; fire tests; electrical equipment

Howorth, R.

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Air Sampling Smoke Detector System.
Consultant, England
Fire Surveyor, Vol. 14, No. 3, 18-23, June 1985.
smoke detection; fire detection systems; smoke detectors; fire detectors; air sampling

Iida, T.

Iida, T.; Kobayashi, S.; Kenmochi, T.
Facilities of the Seikan Tunnel.
Japan Railway Construction Public Corp.
Japanese Railway Engineering, No. 106, 12-16, July 1988.
tunnels; railroads; fire prevention; fire detection systems; fire extinguishing agents; ventilation; exhaust systems

Isaacs, N.

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Engineering Application of Heat Flux Sensors in Buildings--Technical Note.
Building Research Association of New Zealand, Porirua

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heat flux; thermal insulation; in situ combustion; large scale fire tests

Jensen, R.

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Technology of Fire Protection Engineering: The Ultimate Challenge of Our Profession.
Rolf Jensen and Associates, Inc., Deerfield, IL
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Society of Fire Protection Engineers. Fire Detection and Suppression...Today's Technology. Symposium. March 9-11, 1987, Linthicum Heights, MD, Society of Fire Protection Engineers, Boston, MA, 1988.
fire protection engineering

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National Fire Protection Assoc., Quincy, MA
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fire detection; fire detection systems; fire alarm systems

Johnson, J. E.
How Much Radioactivity is There in Smoke Detectors?
National Fire Protection Assoc., Quincy, MA
Fire Journal, Vol. 73, No. 6, 35-36,38-39, November 1979.
smoke detectors; fire protection; ionization detectors

Johnson, L. C.

Johnson, L. C.; Spinweber, C. L.; Webb, S. C.; Muzet, A. G.
Dose Level Effects of Triazolam on Sleep and Response to a Smoke Detector Alarm. Final Report. 1979-1985.
NAVHLTHRSCHCH-85-44; 23 p. Nov. 1985.
Available from National Technical Information Services AD/A-170215
smoke detectors; sleep; dosage; fire alarm systems; reaction time; noise (sound); tolerances (physiology); human beings
Increasing attention is being given to the relative effects of hypnotic dose level on efficacy, sleep structure, and next-day performance. The results of 0.25 and 0.5 mg of triazolam on efficacy, sleep stages, and awakening to a smoke detector when compared to each other and to subjects receiving a placebo are presented. Thirty-six young adult, male subjects with sleep-onset insomnia were equally divided into placebo, 0.25 mg and 0.50 mg triazolam groups to examine the effects of the hypnotic. The 0.25 mg dose is clearly an effective dose level for both sleep efficacy and sedative effects to outside noise. The sedative effects, in some instances, could pose a potential problem.

Kamino, S.

Kamino, S.; Takemoto, A.; Sagae, K.
Variation of Current of an Ionization Smoke Detector as a Function of Compartment Atmosphere.
Maikata-Neagawa Cities Fire Dept., Japan Fire Research Institute, Japan
Japanese Association of Fire Science and Engineering. Annual Conference. May 29-30, 1985, Tokyo, Japan, 23-26 pp, 1985.
In: Japanese (Abstract in English)
ionization detectors; smoke detectors; compartments
Investigation into whether the component influenced by the detector's compartment atmosphere is the ionization gas or an interpolar insulated body inside the ionization compartment. It was found that electric current between external and central poles and internal and central poles is not affected by temperaure, humidity, or air pressure. Conversely, electric current between external and internal poles is easily influenced by absolute humidity.

Kasahara, K.

Kasahara, K.
Fire Detector Utilizing the Expansion Behavior of a Silicone Gum.
Fire Research Institute, Tokyo, Japan
Japanese Association of Fire Science and Engineering. Annual Conference. May 19-20, 1987, Tokyo, Japan, 123-124 pp, 1987.
In: Japanese (Abstract in English)
fire detectors
Silicone gum, which expands when heated, was placed in a tube containing a microswitch on one end and then sealed. When heated, the silicon gum expanded and triggered the microswitch. Although there were some insufficiencies concerning operation time, these could be solved through adjustments in thickness and size of the silicon gum and tube material.

Kellett, J.

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Automatic Fire Detection--Have We been Hoodwinked in Past?
East Sussex Fire Brigade, England
Fire, Vol. 76, No. 938, 105-106, August 1983.
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Optical or Ionization Detectors? The Case for a Combination in High Life Risks.
East Sussex Fire Dept., England
Fire, Vol. 74, No. 913, 93, July 1981.
ionization detectors; fire detection systems; false alarms

Ketola, H. N.

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Evaluation and Testing of Rail Transit Undercar Fire Detection and Suppression Systems. Final Report. January 1986-November 1988.
KETRON, Inc., Cambridge, MA
UMTA-MA-06-0120-89-1; 151 p. August 1989.
Available from National Technical Information Services PB90-107152
railroads; evaluation; fire detection systems; fire suppression; halon 1301; electrical cable; fire safety; fire tests

Kokkala, M.

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Savuilmaisimien toiminta huurruttavissa olosuhteissa. [Smoke Detector Operation in Freezing Conditions.]
VTT, Espoo, Finland
Palontorjuntateknikka, No. 1, 28-29, 1987.
In: Finnish
smoke detectors

Kraus, F. J.

Kraus, F. J.
Brandmeldung im Entstehungsstadium des Feuers--Warmemelder-Flammenmelder-Rauchmelder. [Fire Notification in the Early Stages of Fires--Heat Detection--Flame Detection--Smoke Detection.]
Brandschutz, Vol. 29, No. 7, 193-196, 1975.
In: German
fire detection systems

Kristensen, F. D.

Kristensen, F. D.
Automatic Fire Detection Systems, Rules, Testing, Approval and Control.
DANFOR, Copenhagen, Denmark
Saudi Arabian Standards Organization.
Protection of Buildings From Fires. Symposium.
February 8-10, 1982., Riyadh, Saudi Arabia, 110-123 pp, 1982.
fire detection systems
This technology is utilized for the purpose of rapid alerting by the outbreak of fire, so that appropriate evacuation and extinguishing can be initiated in time, the use of automatic fire detection systems is quite a good example of managed interaction between environment, technique and man. Traditionally, automatic fire detection system rules, testing, approval and control are in accordance with codes specified by National Fire Insurers.

Kruk, R.

Kruk, R.; Urbani, R.
Smoke Detectors and Their Application in Life-Safety Systems.
Electro Signal Lab., Inc.
Consulting/Specifying Engineer, Supplement, 6-9, April 1990.
smoke detectors; life safety; fire detection systems; ionization detectors; photoelectric detectors

Kunz, F.

Kunz, F.; Thalmann, H.
Response Behavior of Smoke Detectors in Theory and Practice.
Fire International, No. 60, 73-81, June 1978.
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Gillette Research Institute, Rockville, MD
Journal of Fire and Flammability, Vol. 7, 71-103, January 1976.
semiconductor devices; sensors; smoldering combustion; flaming combustion; Taguchi gas sensor (Trademark); mine fires

Wainstein, P.

Wainstein, P.
Specification of Fire Alarm Systems. Part 3
C E Electrospec (Pty) Ltd.
Fire Protection, Vol. 10, No. 4, December 1983.
fire alarm systems; smoke detectors; heat detectors

Walsh, J.

Walsh, J.
Mains Powered Smoke Alarms.
Dicon International Ltd.
Fire Surveyor, Vol. 19, No. 1, 9-12, Feb 1990.
smoke detectors; manufacturing

Warren, J. R.

Warren, J. R.
Look at the Next 50 Years.
Boise Interagency Fire Center, ID
Fire Management Notes, Vol. 50, No. 1, 9-12, 1989.
information storage; information retrieval; fire detection; mapping; management

Watanabe, A.

Watanabe, A.
Effectiveness of Active Fire Protection Systems.
Fire Research Inst., Tokyo, Japan
U.S./Japan Government Cooperative Program on Natural Resources (UJNR). Fire Research and Safety. 4th Joint Panel Meeting. February 5-9, 1979, Tokyo, Japan, 22-37 pp, 1979 and Occasional Report of Japanese Association of Fire Science and Engineering. Evaluation of Fire Safety in Buildings. No. 3, 1979, 179-181 pp, 1979 and Conseil International du Batiment. Systems Approach to Fire Safety in Buildings. Volume 1 and Volume 2. August 29-30, 1979, Tsukuba, Japan, III/1-12 pp, 1979.
fire protection; fire detection systems; fire extinguishers; sprinkler systems

Watanabe, A.
Response Characteristics of Smoke Detectors in Early Stage of Fire.
Fire Research Institute, Japan
Nihon Kasaigakkai Ronbunshu, Vol. 21, No. 2, 7-17, 1972.
fire detection; fire research; fire safety; smoke detectors; response time; size distribution; particle size distribution; combustion products; room fires; smoke movement; fire tests

Watanabe, A.; Sasaki, H.; Unoki, J.
Overview on Fire Detection in Japan.
Fire Research Inst., Tokyo, Japan
Nohmi Bosai Kogyo Co., Ltd., Tokyo, Japan
International Association for Fire Safety Science. Fire Safety Science. Proceedings. 1st International Symposium. October 7-11, 1985, Gaithersburg, MD, Hemisphere Publishing Corp., NY, Grant, C. E. and Pagni, P. J., Editors, 679-688 pp, 1986.
fire detection

Waterman, T. E.

Waterman, T. E.; Mniszewski, K. R.; Spandoni, D. J.
Cost/Benefit Analysis of Fire Detectors.
IIT Research Inst., Chicago, IL
69 p. September 1978.
fire detectors; cost benefit analysis; fire incidence

Wessels, E. C.

Wessels, E. C.
Risk Improvement by Active Systems Relative Protection Values for Insurance Considerations. Technical Bureau for Loss Prevention, Baarn, The Netherlands Conseil International du Batiment (CIB). Systems Approach to Fire Safety in Buildings. Volume 2. Session 3. Active Systems Performance and Criteria: Smoke Control, Detection, Sprinklers. Session 4. Passive Systems Performance and Criteria: Combustibles, Fire Resistance. August 29-30, 1979, Tsukuba, Japan, III/1-9 pp, 1979.
fire safety; insurance; sprinklers; fire protection

White, T. M.

White, T. M.; Sutton, A. R.
New Light on Cable Fires. Development in the Protection of Cables in Power Stations.
Central Electricity Generating Board
Fire Prevention, No. 120, 25-28, August 1977.
cable fires; power plants; polyvinyl chloride; installations; smoke; fire detection; fire fighting; fire barriers

Whye, M.

Whye, M.
Military Base Suppresses Fire Automatically.
Fire Engineering, Vol. 138, No. 5, 22-23, May 1985.
fire suppression; military facilities; fire detection systems; fire alarm systems

Wickham, R. T.

Wickham, R. T.
Detectors.
Wormald U.S. Inc., Dallas, TX
Specifying Engineer, Vol. 49, No. 5, 86-88, May 1983.
fire detectors; life safety; fire safety

Willis, J.

Willis, J.; Brooks, D.; Bumpers, V.; Jones, R.; Kelly, T.
Emergency Alarm Systems: Improved Emergency Alarm/Response System. Final Report. February 4, 1985-February 4, 1986.
Metropolitan Transit Authority of Harris County, Houston, TX
UMTA-TX-06-0042-86-1; 132 p. January 1986.

Available from National Technical Information Services PB87-121711
warning systems; transportation; emergencies; false alarms; fire alarm systems; response time
The report provides a perspective on emergency alarms as used by transit properties in general. It describes the range of problems involving the use of alarm systems and further addresses the methods and forms of procedures to help remedy the problem of alarm misuse. It examines transit security problems relating to emergency alarms, including false alarms, malfunctions, misuse of the alarm system and alarm system training.

Wilton, R.

Wilton, R.
Conflict Between Fire and Security Measures.
Chubb Fire Security Ltd., Middx, England
Fire and Materials, Vol. 13, 1-315, March 1988.
Interflam '88. Research Into Practice. 4th International Fire Conference. Conference Workbook. Organised Jointly by Interflam Conferences Ltd. and the Fire Research Station of the Building Research Establishment, in Association With the Royal Institute of British Architects and With EEC Recognition. March 22-24, 1988, Cambridge, England, John Wiley and Sons, New York, Rogers, S. P. and Quarterman, R. M., Editors, 194-196 pp, 1988.
fire detection systems; fire prevention

Yamazoe, N.

Yamazoe, N.; Kurokawa, Y.; Seiyama, T.
Hydrogen Sensitive Gas Detector Using Silver Added Tin(IV) Oxide.
Kyushu Univ., Fukuoka, Japan
Chemistry Letters, No. 12, 1899-1902, 1982.
tin oxides; silver; hydrogen; gas detectors; semiconductors; sensors; sensitivity

Young, R. A.

Young, R. A.; Nash, P.
Fire Protection of Modern High Bay Storages.
Fire Insurers' Research and Testing Organization, Borehamwood, England
Fire Prevention, Science, and Technology, No. 18, 4-13, December 1977.
warehouses; fire protection; sprinkler systems; pallet storage; fire spread; combustibility; fire extinguishment; heat detectors

Younger, G.

Younger, G.
Radioactive Substances (Smoke Detectors) Exemption
(Scotland) Order 1980 SI No. 1599 (S.126).
Atomic Energy and Radioactive Substances.
Secretary of State, Edinburgh, Scotland
INIS-MF-6876; 6 p. October 15, 1980.
Available from National Technical Information Services DE82-780512
smoke detectors; radioactive materials; regulations
This order, which applies to Scotland only, exempts persons conditionally from registration under the Radioactive Substances Act 1960 in respect of the keeping and use of 'radioactive material' within the meaning of that Act as regards smoke detectors incorporating closed sources possessing limited radioactivity. The order revokes and re-enacts with certain amendments the Radioactive Substances (Fire Detectors) Exemption (Scotland) Order 1967.



Economics

This section contains a collection of papers presenting cost-benefit analyses on detectors applied to a range of occupancies from residential [Colville 1990] to industrial [Ramachandran 1981] to historic [Marchant 1989] and general [Unoki 1990]. All such studies on detectors conclude that there is a large, positive ratio of benefit to cost for detectors. Similar studies on residential sprinklers often show the opposite.

Colville, J.

Colville, J.; Behnami, B.
Study of Fire Losses in Multi-Family Residences. Final Report.
Maryland Univ., College Park
297 p. April 1982.
Available from National Technical Information Services PB82-214701
fire losses; multifamily housing; residential buildings; fire safety; fire detection systems; fire resistant materials; sprinkler systems; construction materials; casualties; building fires; smoke detectors
This study, using the computer files of the U. S. Fire Administration National Fire Data Center in Washington, DC, investigated the relationships between construction type and fire losses in multi-family residential buildings. Three measures of fire loss (i.e., extent of flame damage, property losses, and casualties) were considered; also, a review was made of the recorded performance of detectors and sprinklers in these structures. Eight construction types for 14 states, and four construction types for California were considered; data from California was dealt with separately in several areas of the study.

Durkin, P.

Durkin, P.
Sweetening the Pot--Congress Takes a A Closer Look at Tax Credits for Automatic Fire Protection Systems.
International Fire Cheif, Vol. 50, No. 7, 19-21, July 1984.
fire detection; fire alarm systems; fire protection; legislation

Ehrenkrantz Group

Ehrenkrantz Group
Cost Impact of Duplicate Life and Safety Requirements in Codes. Final Report.
Ehrenkrantz Group, Washington, DC
HUD-0002970; 126 p. July 1983.
Available from National Technical Information Services PB84-188242
building codes; life safety; smoke detectors; multifamily housing; cost benefit analysis; fire safety
Conformance to model housing codes in the 1952 to 1977 period increased the cost of multifamily housing by less than 2 percent, but reduced the cost of single-family homes and low-rise apartments. This study sought to determine if compliance with code revisions in the 25 year period would have resulted in costs that exceeded benefits. The three model codes analyzed were the Uniform Building Code, the Basic Building Code, and the Standard Building Code. The study found that during this period, housing costs, increased due to interest rates, permits and fees, labor rates, processing time, and consumer preference, none of which can be attributed to model codes. The model codes, though significantly expanded, became more flexible and performance oriented, often allowing traditionally specified materials to be replaced by lower cost alternatives. The study also found that the rapid growth in the use of smoke detectors, now required by all model codes, has been a major factor in reducing the loss of life due to residential fires. While cooperation between the model code organizations has led to several joint efforts at uniformity, local level enforcement practices vary greatly. Recommendations for improving the code revision process, code changes, a guide to the variables used in the regression analysis, an explanation of the prototypic housing used in the analysis, and 21 references are supplied.

Gardham, J. H. T.

Gardham, J. H. T.
Financial Effects on County and Voluntary Residential Premises.
Consultant, England
Fire Service Technical College. Automatic Fire Detection in Non-Domestic Residential Premises. Technical Study. Paper 9. April 3-5, 1978, Gloucestershire, England, 68-74 pp, 1978.
residential buildings; fire detection; elderly persons

Gomberg, A.

Gomberg, A.; Buchbinder, B.; Offensend, R. L.
Evaluating Alternative Strategies for Reducing Residential Fire Loss--The Fire Loss Model.
National Bureau of Standards, Gaithersburg, MD
NBSIR 82-2551; 66 p. August 1982.
Available from National Technical Information Services PB82-263369
cost benefit analysis; fire losses; fire safety; residential buildings; smoke detectors; sprinkler systems

This report provides a preliminary documentation of a decision analysis framework for evaluating alternative residential fire loss reduction strategies. The framework, when it is completed, will provide a systematic means for assessing the costs and losses occurring under different intervention strategies. The current report focuses entirely on the problem of assessing fire losses, as this is where most of the uncertainty on system performance occurs. Subsequent reports will address the cost of the alternatives, after which the alternatives can be compared on a comprehensive cost/benefit basis. Three alternatives are considered in this preliminary report: smoke detctors, residential sprinkler systems with standard commercial-type sprinkler heads, and a combination of both measures. Based on the preliminary input data developed, the preliminary analysis indicates that both sprinklers and detectors are effective in reducing life loss. Detectors appear to be somewhat more effective in reducing personal losses, however, because of their earlier warning capability. Sprinklers appear to be significantly more effective that detectors in reducing property loss because of their earlier start in initiating suppression. Work is underway refining
the loss model and developing a cost model so that meaningful cost/benefit comparisons of the alternatives can be conducted.

Helzer, S. G.

Helzer, S. G.; Offensend, F. L.; Buchbinder, B.
Decision Analysis of Strategies for Reducing Upholstered Furniture Fire Losses. Final Report.
National Bureau of Standards, Gaithersburg, MD
NBS TN 1101; 155 p. June 1979.
Available from Government Printing Office
building fires; cost benefit analysis; costs; decision analysis; fire losses; furniture; hazard analysis; probability; residential buildings; sensitivity analysis; smoke detectors; standards; upholstered furniture
Decision analysis is used to evaluate alternative strategies for reducing residential upholstered furniture fire losses. Three alternatives are evaluated: no-action, mandatory smoke detector installation, and the proposed upholstered furniture standard under consideration by the Consumer Product Safety Commission. Quantitative models are developed to assess fire losses and costs under each alternative. The alternatives are evaluated on the basis of minimizing the total cost plus loss to society over time. Subject to the assumptions set forth in the report, the analysis shows that the detector alternative and the proposed standard are essentially equivalent and preferred to the no-action alternative. The proposed standard is more effective in saving lives, whereas the detector alternative is less costly to implement. The sensitivity of the results to key assumptions and input parameters is tested. The results are shown to be particularly sensitive to the cost of the proposed standard, the loss of life value assignment, and the upholstered furniture replacement pattern.

Marchant, E. W.

Marchant, E. W.
Preventing Fire in Historic Buildings: The Acceptable Risk.
Edinburgh Univ., Scotland
Fire Technology, Vol. 25, No. 2, 165-176, May 1989.
historic buildings; fire safety; fire risks; management; fire detection systems; smoke control; fire suppression; costs

Platt, S.

Platt, S.
Levels of Detection and Their Cost Effectiveness.
Bury Fire Dept., England
Fire Service Technical College. Automatic Fire Detection in Non-Domestic Residential Premises. Technical Study. Paper 8. April 3-5, 1978, Gloucestershire, England, 62-67 pp, 1978.
fire detection; cost effectiveness; life safety

Ramachandran, G.

Ramachandran, G.
Assessing the Economic Value of Automatic Fire Detectors.
Fire Research Station, Borehamwood, England
Fire, Vol. 73, No. 910, 556-557, April 1981.
fire detectors; economic factors; industries

Ramachandran, G.
Economic Value of Automatic Detectors.
Fire Research Station, Borehamwood, England
Fire Engineers Journal, Vol. 41, No. 122, 36-37, June/September 1981.
fire detectors; fire damage; detection time; fire growth

Ramachandran, G.
Economic Value of Automatic Fire Detectors.
Fire Research Station, Borehamwood, England
IP 27/80; 4 p. November 1980.
fire detectors; economic factors

Ramachandran, G.; Chandler, S. E.
Economic Value of Early Detection of Fires in Industry and Commercial Premises.
Building Research Establishment, Watford, England
IP 13/84; 4 p. July 1984.
economic factors; commercial buildings; industries

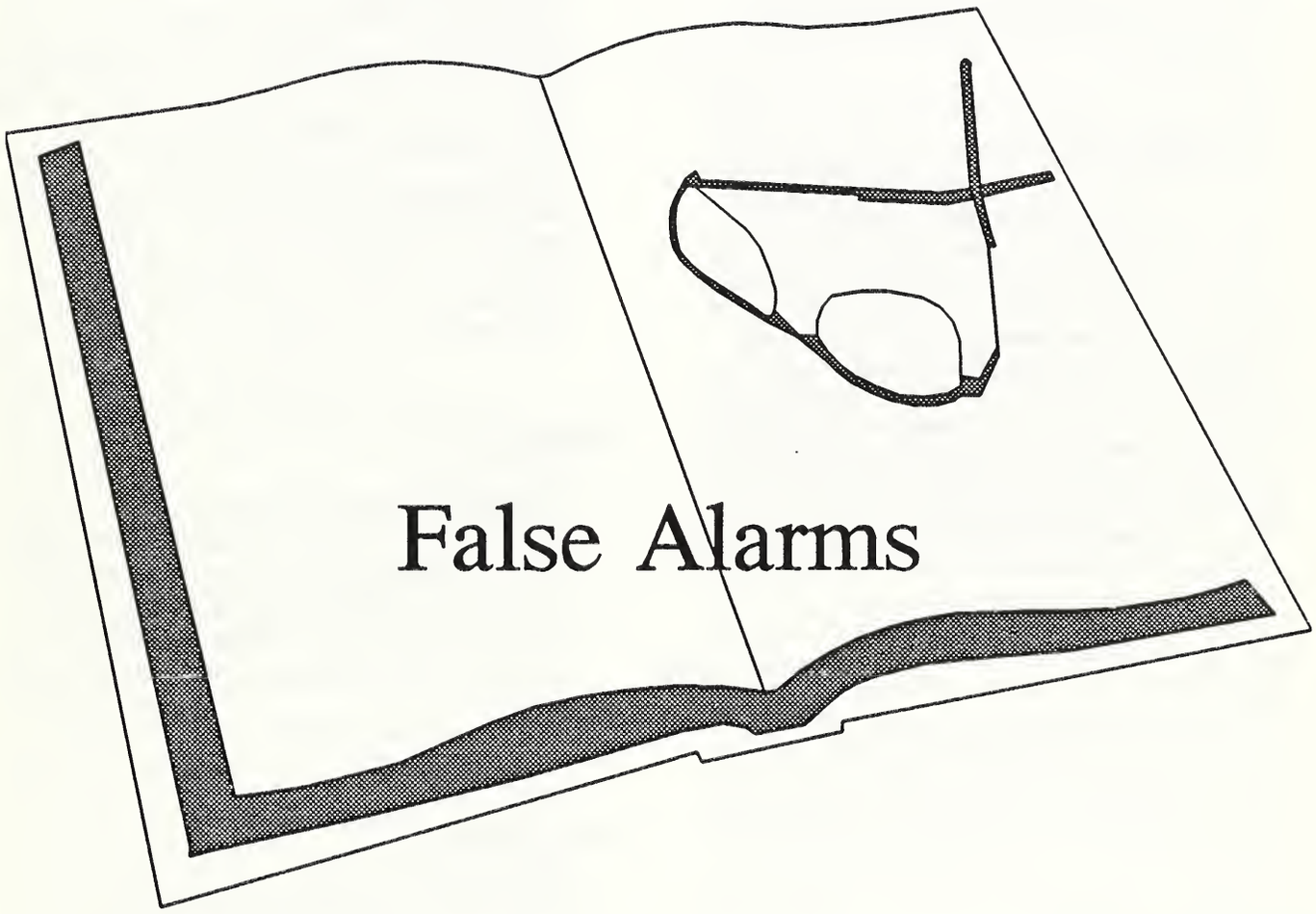
Ramachandran, G.; Chandler, S. E.
Economic Value of Fire Detectors.
Fire Research Station, Borehamwood, England
Fire Surveyor, Vol. 13, No. 2, 8-14, April 1984.
fire detectors

Rutstein, R.

Rutstein, R.
Cost Effectiveness of Building Protection.
Home Office Scientific Branch, England
Fire Engineers Journal, Vol. 38, No. 112, 31-33, December 1978.
sprinklers; fire detectors; cost effectiveness; fire protection

Unoki, J.

Unoki, J.
Some Examples of Calculations Related to Investment Effects of Fire Protection Systems.
11 p. 1990.
In: Japanese (Abstract in English)
fire protection
Examples of calculations to determine the cost of a fire protection system incorporating protected and unprotected areas, average loss anticipated from those areas, estimated cost of direct/indirect loss of those areas, human loss, system cost and accumulated interest are presented. The sum then is viewed in terms of the cost of foregoing a protection system.



False Alarms

This collection of papers demonstrates the international nature of the detector false alarm problem. This section contains numerous papers from the US, Japan, Canada, Germany, Switzerland, and the United Kingdom. The papers read alike - too many false alarms reducing system effectiveness and costing fire departments dearly in lost time. Most blame high detector sensitivity and attempt to resolve the problem by a combination of reducing sensitivity and time delays. Some correlate elevated false alarm rates with ineffective maintenance programs. None claim to have the definitive solution, but one, Fire Journal 1988, describes an effective program undertaken in Boston.

Abe, T.

Abe, T.
Results of Investigation Into False Alarms Produced by Automatic Fire Alarm Systems. (Translation)
Kasai, Vol. 32, No. 6, 16-27, 1986.
false alarms; fire alarms systems
The equipment which is used for the automatic detection of the fire emergency to function as the automatic fire alarm is installed into the vital areas to perform the important duty of informing people inside the building about the incident of the fire emergency. But the main purpose of such an automatic fire alarm system is to discover the fire emergency at the earliest stage and, therefore, the part of the equipment known as the detector is very important so far as the detection of the fire emergency is concerned. This automatic equipment must have sensors like the eye and nose of the human to process or detect the smoke or even the heat, etc. to identify the fire emergency. However, the high-precision results of the equipment will certainly depend on its ability to distinguish and decide the fire emergency accurately to differentiate it clearly from the false situations. In any way, it is demanded from the equipment that it should distinguish clearly whether the smoke or heat is coming from the ordinary cooking place or from the alarming place with the emergency fire. In many automatic fire alarm systems, discrimination is not achieved accurately and the operation of such signals in the detection-environment causes the false functioning of the fire alarm systems.

Anderson, N. H. M.

Anderson, N. H. M.
National Approvals Authority.
Council of British Fire Protection Equipment Manufacturers, England
Home Office Fire Department. Seminar on False Alarms From Automatic Fire Detection Systems. May 5-6, 1982, Gloucestershire, England, 42-47 pp, 1982.
false alarms; manufacturing

Association of European Manufacturers of Fire and Intruder Alarm Systems (EURALARM)

Association of European Manufacturers of Fire and Intruder Alarm Systems (EURALARM)
Study of Unwanted Alarms of Fire Detection and Alarm Systems. EURALARM
Final Document; 9 p. September 1988.
fire detection systems; fire alarm systems; fire statistics
The results of three surveys carried out in the UK, Switzerland and Sweden are listed on pages 5-7 of this document. The studies are based on different sets of classifications of unwanted fire signals and therefore no direct comparison can be made.

Bearman, D. J.

Bearman, D. J.
Current State of the Technology.
British Fire Protection Systems Association PLC Home Office Fire Department. Seminar on False Alarms From Automatic Fire Detection Systems. May 5-6, 1982, Gloucestershire, England, Wiley (John) and Sons, Inc., NY, 12-18 pp, 1982.
false alarms; smoke detectors

Bertschinger, S.

Bertschinger, S.
Smoke Detectors and Unwanted Alarms.
Ontario's Ministry of Government Services, Canada
Fire Journal, Vol. 81, No. 6, 43-45, November/December 1987.
smoke detectors; fire alarm systems

Brannigan, F. L.

Brannigan, F. L.
Delayed Alarms--A Focus for Public Fire Educators.
National Fire Academy, Emmitsburg, MD

Fire Engineering, Vol. 137, No. 10, 53-54, October 1984.
fire alarm systems; safety engineering; false alarms; fire fighters

Breen, D. E.

Breen, D. E.
False Fire Alarms in College Dormitories: The Problem Revisited.
Harvard Univ., Cambridge, MA
SFPE TR 85-03; 20 p. 1985.
false alarms; dormitories; smoke detectors; stairwells; corridors; false alarms

DeWitte, D.

DeWitte, D.
Dossier Securite: Les Fausses Alarmes.
[Security Files: False Alarms.]
Revue Belge du Feu, No. 93, 17-20, Dec. 1988.
In: French

Dubivsky, P. M.

Dubivsky, P. M.; Bukowski, R. W.
False Alarm Study of Smoke Detectors in Department of Veterans Affairs Medical Centers (VAMCS).
National Institute of Standards and Technology, Gaithersburg, MD
NISTIR 89-4077; 234 p. May 1989.
Available from National Technical Information Services PB89-193288
sensitivity; false alarms; smoke detectors; smoking; tests; cleaning; dusts
A study of 133 VA Medical Centers (VAMC), out of a total of 172 throughout the U. S., coupled with visits to 20 facilities, was conducted to gather data on false alarms of smoke detectors. Data collected included name of the detector manufacturer and model number, control unit manufacturer and model number, number and type of detectors installed, where installed, number of false and real alarms for preceding year, date of installation, and policies on smoking, testing, cleaning, and maintenance. VAMC personnel involved with the installations were requested to indicate the maximum level of false alarms that could be tolerated and to provide any recommendations to reduce their occurrence.

Edwards, P. C.

Edwards, P. C.
Home Office View.
Home Office Fire Dept., London, England
Home Office Fire Department. Seminar on False Alarms From Automatic Fire Detection Systems. May 5-6, 1982, Gloucestershire, England, 26-34 pp, 1982.
false alarms; fire detection systems; legislation

Emmons, H. W.

Emmons, H. W.
Fire Detectors for Public Fire Safety.
Harvard Univ., Cambridge, MA
Home Fire Proj. Tech. Rpt. 71; 11 p. Oct. 1985.
smoke detectors; false alarms

Everton, A.

Everton, A.
Why Judge Ruled That Charges for False Fire Alarms Were Illegal.
Barrister-at-Law, England
Fire, Vol. 83, No. 1029, 7, March 1991.
fire alarms; false alarms; fire alarm systems
With the technological advance of the last two decades has come increasing use of automatic fire detection and alarm systems. According to a paper published by the FPA, the advantages lie in the enhanced safety of occupants of a building (by the giving of an early warning of fire), and the reduced loss of property (by the summoning, at an early stage, of the fire brigade). That paper underscores the point that: The most effective systems are connected to the fire brigade or to a central fire alarm depot.

Fire Journal

Fire Journal
How One City is Dealing With the Nuisance Alarm Problem.
Fire Journal, Vol. 82, No. 1, 57-61,82, January/February 1988.
smoke detectors; fire alarm systems; fire prevention; fire departments

Fire Journal
Malicious Alarms or Nuisance Alarms: Which Is the Larger Problem?
Fire Journal, Vol. 83, No. 1, 54, January/February 1989.
false alarms; fire statistics

Fischer, B.

Fischer, B.
Ursachen unerwunschter Alarme und ihre Vermeidung. [Reasons for Unwanted Alarms and Their Avoidance.]
Hekatron GmbH, Federal Republic of Germany
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '89", 9th. September 26-28, 1989, Duisburg, West Germany, Luck, H., Editor, 25-36 pp, 1989.
In: German
false alarms

Frost, P.

Frost, P.
Developments in Equipment Testing and Standards.
Fire Offices' Committee
Home Office Fire Department. Seminar on False Alarms From Automatic Fire Detection Systems. May 5-6, 1982, Gloucestershire, England, 39-41 pp, 1982.
false alarms

Furey, B.

Furey, B.
Detection Defection? Growing Clamor Over Faulty Automatic Alarm Systems.
Valley Cottage Fire Dept., NY
Firehouse, 69-70,73-74, March 1984.
fire alarm systems; false alarms

Green, C.

Green, C.
Developments in Communications.
Home Office Fire Service Inspectorate, England
Home Office Fire Department. Seminar on False Alarms From Automatic Fire Detection Systems. May 5-6, 1982, Gloucestershire, England, 59-61 pp, 1982.
false alarms; fire departments

Guettinger, H.

Guettinger, H.; Scheidweiler, A.
New Ways Towards a Solution of the False Alarm Problem.
Cerberus Ltd., Mannedorf, Switzerland
International Association for Fire Safety Science. Fire Safety Science. Proceedings. 2nd International Symposium. June 13-17, 1988, Tokyo, Japan, Hemisphere Publishing Corp., New York, Wakamatsu, T., Hasemi, Y., Sekizawa, A., Seeger, P. G., Pagni, P. J. and Grant, C. E., Editors, 583-590 p., 1989.
fire research; fire safety; fire science; false alarms; fire detection systems; sensitivity; human behavior

Gupta, Y.

Gupta, Y.; Dharmadhikari, A.
Analysis of False Alarms Given by Automatic Fire Detection Systems.
Manitoba Univ., Canada
Reliability Engineering, Vol. 13, No. 3, 163-174, 1985.
fire alarm systems; accident prevention; probability; false alarms; human beings

Harwood, J.

Harwood, J.
False Alarms From Automatic Fire Detection Systems.
Fire Prevention, No. 152, 19-23, September 1982.
fire alarm systems; false alarms; fire detection systems; statistics

Hozack, J. M.

Hozack, J. M.
Reducing False Alarms in Automatic Fire Detection Systems.
Schindler Fire and Security, England
Fire Protection, Vol. 13, No. 1, 18-2, March 1986.
fire detection systems
The job of an automatic detection system for fire or intrusion is to provide the earliest possible warning in the event of an alarm, in order that intervention at a stage when the developing danger can still be averted relatively easily, can be carried out before serious damage has been done to equipment or property.

Jones, P. G.

Jones, P. G.
Synopsis of the False Alarm Problem.
British Fire Protection Systems Association PLC, England
Home Office Fire Department. Seminar on False Alarms From Automatic Fire Detection Systems. May 5-6, 1982, Gloucestershire, England, 19-25 pp, 1982.
false alarms; fire departments; fire detection

Kasahara, K.

Kasahara, K.
Insect Penetration into the Compartment of a Battery Driven Smoke Detector.
Fire Research Institute, Japan
Japanese Association of Fire Science and Engineering. Annual Conference. May 29-30, 1985, Tokyo, Japan, 19-20 pp, 1985.
In: Japanese (Abstract in English)
smoke detectors; false alarms
Ionization and photoelectric detectors were studied in several city and country locations in Japan. Insect penetration clearly triggered only one false alarm but may have caused three more, for a total of 3%. Insect netting placed in the internal compartment or over the smoke detection opening may effectively prevent insect penetration.

Kitchenham, C.

Kitchenham, C.
Controlling Nuisance Alarms.
Electro Signal Lab., Inc.
Consulting/Specifying Engineer, Supplement, 10-11,14, April 1990.
fire detection systems; contamination; cleaning; installation; maintenance

Kunz, F.

Kunz, F.
Automatische Brandmeldean lagen--ihre Wirksamkeit; Falschalarme und Massnahmen zu ihrer Reduzierung [Automatic Fire Detector Placement - its effectiveness; False Alarms and Measures for its Reduction]
EURALARM, Mannedorf, Switzerland
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '89", 9th. September 26-28, 1989, Duisburg, West Germany, Luck, H., Editor, 11-35 pp, 1989.
In: German
fire detection; false alarms

Larsen, T. E.

Larsen, T. E.
Flame Detectors: Reducing False Alarms.
Detector Electronics Corp.
Fire Surveyor, Vol. 13, No. 1, 21-27, Feb. 1984.
flame detectors; fire detection; false alarms

McLaurin, M. F.

McLaurin, M. F.
Controlling Private Security System False Alarms.
International City Management Assoc., Washington, DC
MIS Report, Vol. 16, No. 7, 1-12, July 1984.
false alarms; operations research; costs; statistics

Mettler, H.

Mettler, H.
Zur problematik echter und unechter Alarme von Brandmeldeanlagen. [On the Dilemma of Valid and False Alarms From Fire Detection Systems.]
Vereinigung Schweizerischer Hersteller von Alarmanlagen, West Germany
SFZ/JSPS, 541-545, October 1986.
In: German
false alarms; fire detection systems

Miyama, J.

Miyama, J.; Jin, T.; Saito, F.
Progress Report on Fire Detection.
Sophia Univ., Bulgaria
Fire Research Inst., Tokyo, Japan
Building Research Inst., Tokyo, Japan
U.S./Japan Government Cooperative Program on Natural Resources. Fire Research and Safety. 6th Joint Panel Meeting of the UJNR Proceedings. May 10-14, 1982., Tokyo, Tsukuba, Japan, Building Research Inst., Tokyo, Japan, 2-9 pp, 1983.
fire detection; fire alarm systems; smoke detectors
This report consists of statistical investigation of the frequency of fire alarms including false ones concerning twelve large-scale buildings, experimental research on the performance of smoke detectors under several kinds of smoldering smoke, a light-absorption type smoke detector recently developed, and the relation between visibility in smoke and the performance of smoke detctors from the viewpoint of taking evacuation.

Miyama, J.; Watanabe, A.
False Alarm of Smoke Detectors.
Illuminating Engineering Inst., Japan
National Bureau of Standards. Fire Research and Safety.
3rd Joint Panel Proceedings Conference of the U.S. Japan Cooperative Program in Natural Resouces. March 13-17, 1978, Gaithersburg,

MD, National Bureau of Standards, NBS SP 540, Sherald, M. A., Editor, 46-53 pp, 1979.
Available from Government Printing Office SN-003-003-02141-5
false alarms; smoke detectors
The causes of false alarm of smoke detectors are described together with the standards for device and installation of smoke detectors, and the means to avoid false alarm are presented.

Moore, W. D.

Moore, W. D.
Fire Alarm Systems "Crying Wolf".
Mass Fire Alarms of New England, Lowell, MA Society of Fire Protection Engineers. Fire Detection and Suppression...Today's Technology. March 9-11, 1987, Linthicum Heights, MD, 1-9 pp, 1987.
fire alarm systems; false alarms; smoke detectors; sensitivity
False alarms, primarily from smoke detectors, play a major role in decreasing the credibility of a fire alarm system and their psychological impact may well be the most vulnerable link in our early warning systems as installed today.

Morgenstern, R. D.

Morgenstern, R. D.
False Alarms.
Congressional Budget Office, Washington, DC Urban Analysis, Vol. 4, No. 2, 221-234, 1977.
false alarms; fire departments; evaluation; fire alarm systems The subject of this case is false alarms, an increasing problem for fire departments in many areas of the country. In the body of the case we outline the nature of the problem and discuss the objectives and the criteria to be used in the evaluation. We then analyze one particular alternative: namely, discretionary response.

Mottler, H.

Mottler, H.
Au sujet de la problematique des fausses alarmes et des alarmes reelles produites par les installations de detection d'incendie. [On the Subject of the Problem of False Alarms and Real Alarms Produced by Fire Detectors.]
SFZ/JSPS, 541-545, October 1986.
In: French
detector response

Peacock, S. T.

Peacock, S. T.; Kamath, A. R. R.; Keller, A. Z.
Reliability Appraisal of Fire Detection Systems.
Bradford University Research Ltd., UK Report, 1-20 pp [no date]
fire detection systems; reliability; chemical plants; false alarms; maintenance
The performance of Automatic Fire Detection Systems specifically with respect to reliability is discussed. It is shown that these systems are particularly susceptible to spurious alarms. Causes of these spurious alarms are identified and are shown to be dependent on a large number of factors ranging from the enviornment to operational procedures. The consequential reduction in the credibility of such systems raises questions regarding expediency of use, especially in high risk areas.

Peacock, S. T.; Wagstaff, T.
Statistical Analysis of False Fire Alarms From Hospitals.
Bradford Univ., UK
Department of Health and Social Security, London, England
Advances in Reliability Technology Symposium, 7th. 1982, 2C/4-11 pp, 1982.
hospitals; false alarms; statistical analysis; smoke detectors; heat detectors; tests
This paper is concerned with a statistical analysis of false alarms from fire alarm systems in eleven hospitals within one Area Health Authority (A.H.A.) of the Department of Health and Social Security. Data from the Local Authority Fire Brigade covering a two year period is analysed using various statistical techniques. These include the classificaion of causes of false alarms; calculation of alarm rates; analysis of variance to investigate the influence of the time and day of occurrence of alarms; Weibuil analysis of the times between false alarms; investigaton of the growth/reduction of false alarms with time using a non-homogeneous Poisson process model. The analyses are combined to obtain a global model of false alarms.

Pigott, B. B.

Pigott, B. B.; Burry, P. E.
Future Technology.
Fire Research Station, Borehamwood, England
Home Office Fire Department. Seminar on False Alarms From Automatic Fire Detection Systems. May 5-6, 1982, Gloucestershire, England, 48-58 pp, 1982.
false alarms

Platt, S.

Platt, S.
Identifying the Solutions.
Home Office Fire Department. Seminar on False Alarms From Automatic Fire Detection Systems. May 5-6, 1982, Gloucestershire, England, 62-66 pp, 1982.
false alarms

Rajan, K. S.

Rajan, K. S.; Snelson, A.; Schechter, H. R.; Mniszewski, K. R.; Waterman, T. E.; Yamate, G.; Harpe, S. W.
New Concepts of Fire Detection.
IIT Research Inst., Chicago, IL
Underwriters Laboratories, Northbrook, IL
97 p. December 1978.
fire detection systems; false alarms
This study was directed toward defining the differences in response of various detection concepts to both real and false fire signatures. Section 2 discusses the "multimode" detection concept of systems employing more than one detection mode and/or requiring more than one detector to operate prior to general alarm. Measurements of the response of the principal detector types to common household contaminants is presented as a guide to the design of future multimode systems.

Rankin, S.

Rankin, S.
Operational Perspective. Part 1.
Chief Fire Officer, Merseyside, England
Home Office Fire Department. Seminar on False Alarms From Automatic Fire Detection Systems. May 5-6, 1982, Gloucestershire, England, 3-5 pp, 1982.
fire departments; fire alarm systems

Scheidweiler, A.

Scheidweiler, A.; Guttinger, H.
Reducing False Alarms From Smoke Detectors.
Cerberus AG, Mannedorf, Switzerland
Fire International, Vol. 14, No. 125, 77-78, October/November 1990.
false alarms; smoke detectors; sensitivity; fire alarm systems

Sekizawa, A.

Sekizawa, A.; Takemoto, A.; Kasahara, K.
Research on False Alarms From Battery Driven Fire Detectors Monitored in Residential Houses.
Fire Research Institute, Japan
Japanese Association of Fire Science and Engineering. Annual Conference. May 29-30, 1985, Tokyo, Japan, 27-28 pp, 1985. In: Japanese (Abstract in English)
false alarms; fire detectors; residential buildings
Based on 1981 and 1982 surveys with nearly identical results. Contains figures on frequency, cause, and expectation of false alarms (for example, 80% of the households had experienced false alarms while asleep, 40% while cooking).

Takemoto, A.

Takemoto, A.
Abnormal Output as One of False Alarms From an Ionization Smoke Detector.
Fire Research Institute, Japan
Japanese Association of Fire Science and Engineering.
Annual Conference. May 20-22, 1986, Tokyo, Japan, 55-58 pp, 1986.
In: Japanese (Abstract in English)
false alarms; ionization detector; smoke detectors
Using automated data gathering measures, abnormal output and possible countermeasures were studied. As a result, it was found that abnormal output is random and one cannot specify the correlation between abnormal output and temperature, humidity, time of day, or season.

Takemoto, A.
False Alarm From a Battery Driven Ionization Smoke Detector.
Fire Research Institute, Japan
Japanese Association of Fire Science and Engineering.
Annual Conference. May 29-30, 1985, Tokyo, Japan, 17-18 pp, 1985.
In: Japanese (Abstract in English)
false alarms; ionization detectors; smoke detectors
Two groups of ionization detectors aging from 1-3.5 years old were submitted to different temperature, relative humidity and time conditions. Dust and lint were found in the ionization compartments or on the internal poles of all detectors triggered by humidity. Dust and lint formed a bridge between the central compartment and the internal poles, absorbed moisture and set off the alarms.

Takemoto, A.
False Alarms as a Function of Atmosphere Change in a Compartment.
Fire Research Institute, Japan
Japanese Association of Fire Science and Engineering. Annual Conference. May 20-22, 1986, Tokyo, Japan, 59-62 pp, 1986.
In: Japanese
false alarms; compartments

Takemoto, A.; Kasahara, K.; Sekizawa, A.
False Alarms Given by Fire Detectors Driven by a Battery.
Fire Research Institute, Tokyo, Japan
Japanese Association of Fire Science and Engineering. Annual Conference. May 22-23, 1984, Tokyo, Japan, 65-66 pp, 1984.
In: Japanese (Abstract in English)
false alarms; fire detectors
By sorting operation density, two models each of ionization and photoelectric type detectors were evaluated.

Fisher's official linear law was used to calculate the trigger rate. Differences in both the detector type and model were noted when tested in kitchens and cafeterias. Use and position of a ventialtion fan also influenced whether the detector was triggered.

Takemoto, A.; Kouzeki, D.; Watanabe, M.; Yamauchi, Y.; Mammoto, A.
On the Cause for False Alarms and Its Duration--In Case of Hotel Guest Rooms.
Japanese Association of Fire Science and Engineering. Fire Research Annual Conference. May 17-18, 1990, 63-64 pp, 1990.
In: Japanese (Abstract in English)
fire research; false alarms; hotels
In evaluations of data from hotels on false alarms caused by steam and tobacco smoke, it was determined that a storage time of 10 seconds, 1/3 the norm, was sufficient.

Takemoto, T.

Takemoto, T.
View of Causes for False Alarms of Ionized Fire Alarm Systems.
Fire Prevention Laboratory of Ministry of Home Affairs, Japan
Paper 5; 8 p. 1985.
Japanese Association of Fire Science and Engineering. Annual Conference on Fire Research. May 29-30, 1985, Paper 5, 1985.
smoke detectors; false alarms

Unoki, J.

Unoki, J.
False Alarms of Fire Detectors and Further Action Against Them in Japan.
Nohmi Bosai Kogyo Co., Inc., Japan
7 p. February 1984.
fire detectors; false alarms; fire alarm systems; buildings; human factors engineering; detector location; fire departments; fire statistics Tokyo Fire Department have surveyed false alarms of fire detectors during one year from August 1980 to July 1981 about 1,500 buildings where automatic fire alarm systems are installed.

Usuba, T.

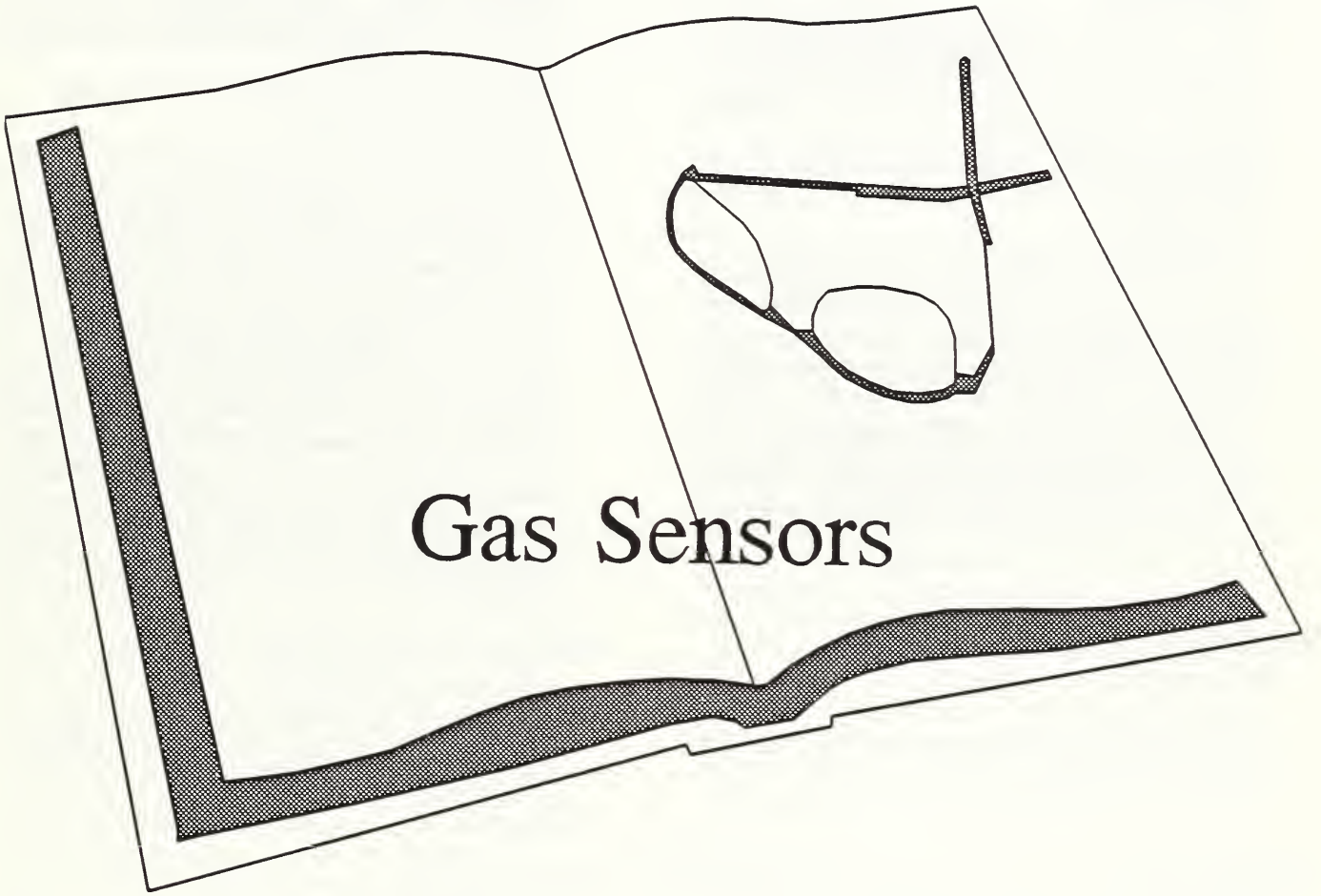
Usuba, T.; Nakano, M.; Iwama, N.
False Alarms of Ionization Smoke Detectors Caused by Changes in Room Environment: When Dust and Threads Are Stuck to Poles.
Sophia Univ., Japan
Japanese Assoc. of Fire Science and Engineering. Annual Conference. May 20-22, 1986, Tokyo, Japan, 67-68 pp, 1986.
In: Japanese (Abstract in English)
temperature; compartments
Lint and dust may adhere to the poles in the ionization compartment. These may absorb moisture from the air. This absorption time may vary according to air current speed. Different experiments were conducted with acrylic thread, air conditioning, moisture emitted from a tea kettle, etc.

Whitaker, E. H.

Whitaker, E. H.
Operational Perspective. Part 2.
Chief Fire Officer, East Sussex, England
Home Office Fire Department. Seminar on False Alarms From Automatic Fire Detection Systems. May 5-6, 1982, Gloucestershire, England, 6-11 pp, 1982.
fire risk; fire statistics; false alarms

Wollin, G.

Wollin, G.
Measures for Reducing the Level of Unwanted Alarms Arising From Fire Detection and Alarm systems. Tele-Larm, Sweden
Final Document; 29 p. July 1987.
fire detection systems; fire alarm systems; fire statistics
The EURALARM document "measures for redicing the level of unwanted alarms arising from fire detection and alarm systems" has been prepared by the Working Group 1. This document is a follow-up to an earlier Euralarm document, entitled "Study of Alarms". Its purpose is to recommend defensive and preventive measures that can be taken to reduce the level of unwanted alarms identified in the earlier study. Ideally they should be applied at the planning stage, but many of them may be of value in reducing unwanted alarms from existing installations. The advice provided is directed towards systems that may or not have connections to a fire brigade or a central monitoring station having the responsibility for summoning the fire service. As both products and systems will vary from company to company, these recommendations are general in nature and are not related to any specific technology or system concept. Also, no attempt has been made to cover forecasts and trends as again these would differ widely both from company to company and country to country. The recommendations being put forward in this document, can be expected to make a significant contribution to reducing the level of unwanted alarms from fire detection and alarm systems.



Gas Sensors

This topic includes papers on modern applications of gas sensing fire detectors - a category of detectors recognized by US standards but generally not employed in this country. Of particular interest are several papers from the UK [Jones 1990, Ross *et al* 1990, Harrison *et al* 1990, Sonley 1990, and Southall 1983] which discuss such applications. Additionally, there are presentations of gas sensing techniques which have not previously been seen in the US [Ross 1990, Sonley 1990, Susott 1979, and Handa 1983].

Affens, W. A.

Affens, W. A.
Effect of Halon 1301 Fire Extinguishing Agent on the Response of Combustible GasIndicators. Final Report.
Naval Research Lab., Washington, DC
NRL-MR-4150; 20 p. January 18, 1980.
Available from National Technical Information Services AD/A-080529
fire hazards; warning systems; degradation; fire extinguishing agents; gas detectors; filiaments; sensitivity; shipboard fires
A combustible gas indicator (CGI) was tested in combustible vapor-air mixtures with and without the presence of Halon 1301 vapors. GCI response to hydrocarbon vapors was reduced on the average of about 30 percent in the presence of Halon 1301 vapors at fire extinguishment concentrations for hydrocarbon-type fire (3.7 percent) and about 45 percent at inerting concentrations (7.4 percent). Some filament deterioration was noted in filaments which were exposed to Halon vapors. Sensitivity loss for these filaments averaged about 9 percent.

Berkovitch, I.

Berkovitch, I.
Gas Sensors.
Manufacturing Chemist, Vol. 57, No. 2, 60, 1986.
sensors; gas detectors

Bright, R. G.

Bright, R. G.
Do Gas Sensors Meet Smoke Detector Requirements?
National Bureau of Standards, Gaithersburg, MD
Fireline, Vol. 3, No. 3, 5-7,15, May/June 1978.
smoke detectors; fire tests; taguci gas sensor (trademark); sensitivity
Recently, there has appeared on the U. S. market a new type of fire detector, which utilizes as its basic sensing mechanism, a semiconductor, solid-state device commonly referred to as a Taguchi gas sensor (TGS).

Bright, R. G.
Report of Fire Tests on Eight TGS Semiconductor Gas Sensor Residential Fire/Smoke Detectors. Final Report.
National Bureau of Standards, Gaithersburg, MD
NBSIR 76-990; 16 p. April 1976.
Available from National Technical Information Services PB-251769
fire detectors; taguchi gas sensor (trademark); gas detectors; smoke detectors
At the request of the Bureau of Engineering Sciences Consumer Product Safety Commission, twenty-four Taguchi gas sensor (TGS) detectors, representing eight manufacturers were tested to the requirements of Section 22 (base sensitivity tests) and Section 24 (full-scale fire tests) of Underwriters' Laboratories Standard No. 217, "Standard for Single and Multiple Station Smoke Detectors". Two conventional single-station smoke detectors, one an ionization chamber type and the other a photoelectric type, were included in the test series for comparison. Only one of the TGS detectors was able to meet the requirements of Section 22, base sensitivity tests. None of the TGS detectors were able to meet the requirements of Section 24, full-scale fire tests. The two conventional smoke detectors met the requirements of Section 22 and 24.

Chemistry and Industry

Chemistry and Industry
Fire Sensors and Microchips Don't Add Up.
Chemistry and Industry, Vol. 23, No. 5, 874, December 1983.
sensors

Combley, R. C.

Combley, R. C.
Flammable Gases: Hazards and Detection.
Fire Surveyor, Vol. 16, No. 1, 22-27, Feb. 1987.
flammable gases; explosions; fuels; flash point; density effects; ignition; flameproofing; certification; vapors

Davies, D.

Davies, D.
Why Storage Risks Need Gas Detection.
Risk Control Services
Fire, Vol. 80, No. 994, 31, April 1988.
hospitals; storage; warehouses; gas detectors

Fire

Fire
Variety of Risks on Oil Rigs: Case for Portable Gas Detection.
Fire, Vol. 76, No. 937, 54, July 1983.
offshore platforms; paints; toxic gases; vapors

Fire Research Station

Fire Research Station
Guide to the Use of Portable Flammable Gas Detectors.
Fire Research Station, Borehamwood, England
CP 33/77; 7 p. July 1977.
gas detectors; flammable gases; vapors

Handa, T.

Handa, T.; Fukaya, H.; Kojima, K.; Endo, K.; Okayama, Y.
Current-Voltage Characteristics of Pt-Sn02 Point-Contact.
Science University, Tokyo, Japan
Nohmi Bosai Co., Ltd., Japan
Society of Materials Science, Japan. Japan Congress on Materals Research, 23rd. 1980, 220-224 pp, 1980.
electric potential; gas detectors; carbon monoxide
Seiyama et al, developed ZnO type ceramic gas detector in 1962. Since then, many study have been made so far on the ceramic gas detectors. However, it is no exaggeration to say that technology in this field is not yet established, because of the difficulty in the response of the sinterred bulky device during the long time exposure in the actual envirnment as well as the uniform response of the products. Almost all of gas sensors commercially available for the detecting appliance are equipped with various kinds of heater panel in ordinary service for excluding the effect from the moisture and other environmental gases and also for endowing a quick response time to the sensor. However, the single most difficulty in the use of the present sensors for fire detector is in that they can not preferentially detect CO gas or other products specific to smoldering fire sources. The present authors explored the possibility for developing a device which can exclude the effect of moisture and others gases in the environmental atmospheres without any heating panel and which can also detect preferentially CO and other polar gases specific to smoldering fire. This paper treats with the details of the point-contact cell device employing Pt-electrode and sinterred Sn02 wafer, and their Current(I)-Voltage(V) characteristics.

Handa, T.; Fukaya, H.; Sugawa, O.; Terasawa, Y.; Endoh, K.; Okayama, Y.
Calcination Temperature Effects to CO-Gas Sensor of Pt-Dispersed Hydrous SnO2 Gel.
Science Univ. of Tokyo, Japan
Nohmi Bosai Kogyo Co., Ltd., Tokyo, Japan
Fire Science and Technology, Vol. 3, No. 1, 1-12, 1983.
carbon monoxide; ceramics; temperature; moisture

Harrison, P. G.

Harrison, P. G.; Willett, M. J.
Mechanism of Operation of Tin (IV) Oxide Carbon Monoxide Sensors.
Nottingham Univ., England
Nature, Vol. 332, No. 6162, 337-339, March 24, 1988.
carbon monoxide; sensors; gas detectors; adsorption; tin; spectroscopy; infrared spectroscopy; electrical resistivity

Jones, T. A.

Jones, T. A.
Semiconductor Gas Sensors.
Health and Safety Executive, Sheffield, England
IEE Colloquium Digest, Vol. 1985, No. 54, 1-4, 1985.
IEE Colloquium on Solid State and Smart Sensors. May 14, 1985, London, England, 1985.
gas detectors; sensors; semiconductor devices; metal oxides
In this paper the advantages and disadvantages of this type of gas sensor are discussed and illustrated with reference to two sensors which use a metal oxide and an organic semiconductor respectively. The first is based on a single crystal of ZnO which can be used either for measurement of low levels of CO or for providing an early indication of onset of a fire by detecting the gaseous products evolved. The second, based on a film of lead phthalocyanine (PbPc), provides a means of selectively detecting strongly electrophilic gases such as NO2 and C12.

Okayama, Y.

Okayama, Y.; Handa, T.; Fukaya, H.; Maruyama, T.; Endo, K.
Carbon Monoxide Sensor Element Made of SnO2-Sb203-Pt Semiconductor.
2 p. 1990.
In: Japanese (Abstract in English)
carbon monoxide; sensors; semiconductors
Report of electric resistance characteristics in CO dense gas sensor element. This uses gas adsorption on a semi-conductor surface at a normal temperature, unlike other CO sensor elements which must be heated to maintain their particle surface temperature (200-300 deg C).

Okayama, Y.; Hotta, H.
Composite Type Silane Sensor.
4 p. 1990.
In: Japanese (Abstract in English)
sensors
A silane gas sensor was developed to detect both combustible and non-combustible components. An ionization sensor, best able to detect combustible components, and a semi-conductor type sensor, able to detect gaseous SiH4 were combined. This model was effective in tests on all three SiH4 states.

Ross, J. F.

Ross, J. F.; Terry, C. I.; Webb, B. C.
New Method for Protection Against Electrical Overheating Using a Sacrificial Coating and a CHEMFET Gas Sensor.
THORN EMI Central Research Lab., Hayes, England
Journal of Physics E: Scientific Instruments, Vol. 19, No. 7, 536-540, July 1986.
sensors; overheating; coatings; ureas; ammonium phosphates

Schaeffer, M. J.

Schaeffer, M. J.
Use of Combustible Detectors in Protecting Facilities From Flammable Hazards.
Control Instruments Corp.
ISA Transactions, Vol. 20, No. 2, 25-30, 1981.
gas detectors; flammable gases; sensors; detector location; hazardous vapors

Sonley, J. M.

Sonley, J. M.
Detection of Flammable Gases in an Offshore Environment.
International Gas Detectors Ltd., UK
BHRA, The Fluid Engineering Center; Society of Fire Protection Engineers; Safety and Reliability Directorate of UKAEA and Institution of Chemical Engineers. Fire Engineering in Petrochemical and Offshore Applications. International Conference Proceedings. June 23-24, 1987, Stratford-upon-Avon, England, Paper C2, 45-48 pp, 1987.
offshore platforms; flammable gases; gas detectors; infrared detectors

Southall, G.

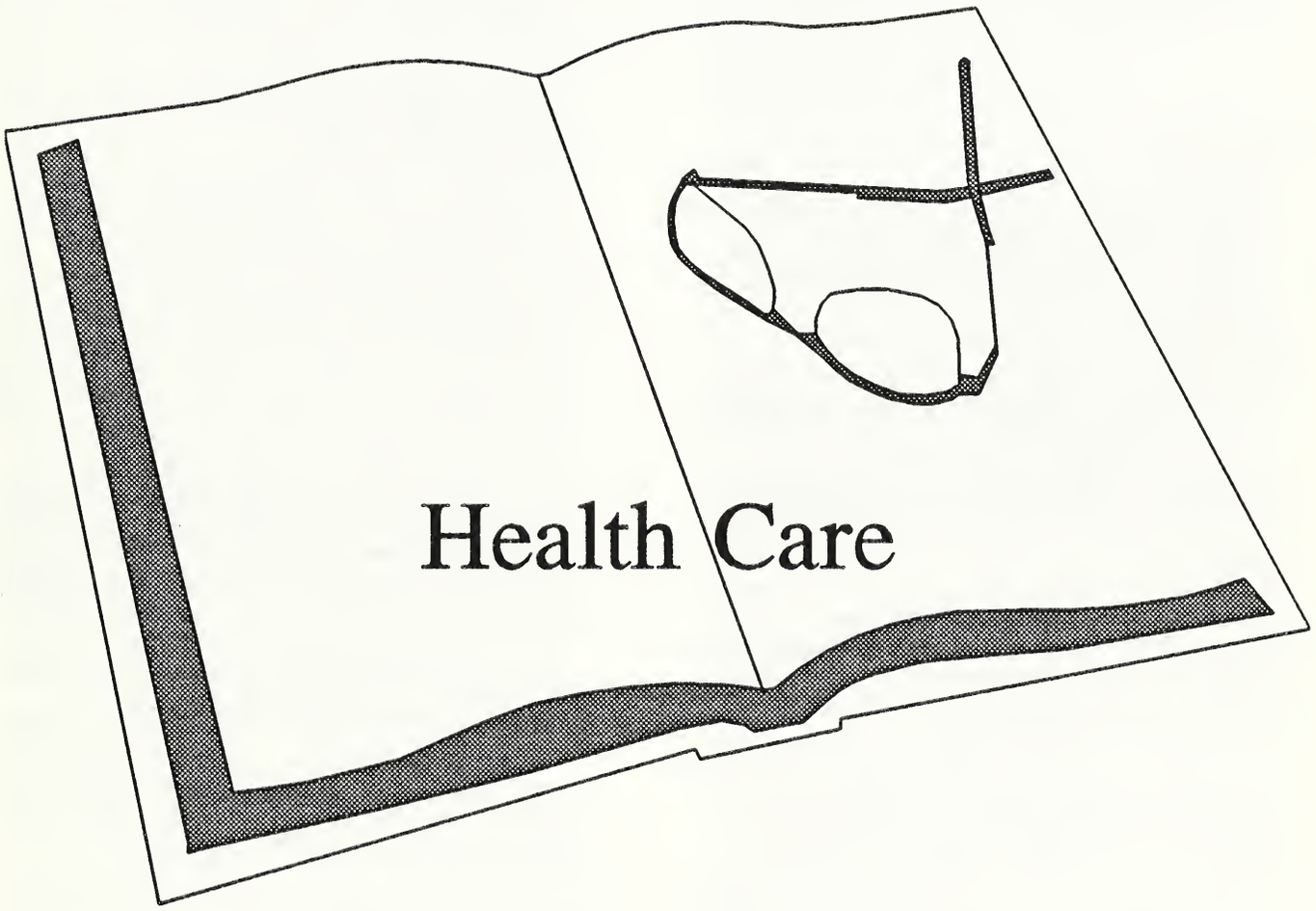
Southall, G.
Gas Detection 'Coming Along Nicely' as Semiconductors are Developed.
Electronic Devices Ltd., Worcester, England
Fire, Vol. 75, No. 931, 416, January 1983.
gas detectors; offshore platforms; semiconductors

Susott, R. A.

Susott, R. A.; Shafizadeh, F.; Aanerud, T. W.
Quantitative Thermal Analysis Technique for Combustible Gas Detection.
Forest Service, Ogden, UT
Montana Univ., Missoula
Journal of Fire and Flammability, Vol. 10, No. 2, 94-104, April 1979.
gas detectors; thermal analysis; combustibles; solids

Umezu, M.

Umezu, M.; Makino, Y.; Yamao, S.
Semiconductor Sensor for Gas Detector.
National Research Institute for Pollution and Resources 10 p. 1977.
semiconductors; gas detectors; metal oxides; LP gas; carbon monoxide



Health Care

This topic area is dominated by a large series of papers by Bryan presenting occupant behavior analyses in fire incidents in health care facilities in which detectors and sometimes sprinklers are present. Thus, these works document the performance of detection systems in actual use. Several of the papers dealing with the present debate on the need for detectors in the presence of "quick response" sprinklers also are included.

As with gas sensors, the British have been quite active in this area. There are a series of papers by British authors which detail the utilization of detectors and sprinklers in health care facilities in the UK. Two of these papers [Todd 1989 and Palmer 1988] examine the detector/sprinkler question based on full-scale test results. They conclude that, while the quick response sprinkler acts to suppress a bed fire, the cooling of the gas layer causes decreased visibility and increased patient exposure to toxic gases. Thus, they feel that rapid detection/notification of staff for patient evacuation of the fire zone provides the optimum arrangement at present.

Bryan, J. L.

Bryan, J. L.; DiNenno, P. J.
Examination and Analysis of the Dynamics of the Human Behavior in the Fire Incident at the American Nursing Home and Convalescent Center on May 11, 1978.
Maryland Univ., College Park
NBS-GCR-80-216; 32 p. August 31, 1978.
Available from National Technical Information Services PB80-192677
evacuation; fire departments; fire extinguishers; fire investigations; mattresses; nursing homes; nursing staff
The fire incident at the American Nursing Home and Convalescent Center on May 11, 1978 was detected by the nursing staff at approximately 1540 hours. The fire at detection involved a polyurethane mattress on an unoccupied bed in patient room 308, the third floor west wing. The three-story and basement building of fire resistive construction was erected in 1973. At the time of the fire incident, the building had a registered occupancy of 265 patients. The fire was confined to the mattress of the bed in room 308 and essentially extinguished by nursing personnel with a 6 pound, 2A, 40BC rated extinguisher. The fire department was notified and responded, with their services being limited to salvage, overhaul and smoke removal. Nine nursing staff, including the Director of Nursing, evacuated the approximately twenty-five patients in the fire zone to other areas on the third floor in a two phase evacuation prior to fire department arrival. There was no patient or staff injuries in this fire incident, including the extinguishing operations.

Bryan, J. L.; DiNenno, P. J.
Examination and Analysis of the Dynamics of the Human Behavior in the Fire Incident at the Crownsville Hospital Center on January 26, 1979.
Maryland Univ., College Park
NBS-GCR-80-233; 26 p. June 30, 1979.
Available from National Technical Information Services PB80-208986
evacuation; fire departments; fire extinguishers; fire investigations; patients; smoke; sprinkler systems
The fire incident at the Crownsville Hospital Center on January 26, 1979 was detected by a patient at approximately 0420. The fire at detection consisted of a flaming linen bag in the linen room of ward 91 in the Medical-Surgical Building with flames to a reported height of four to five feet. The fire was reported by phone to the facility operator, and the local alarm system was activated, and the fire department notified. Approximately twenty-five patients were on ward 91 at the time of the fire incident. Fifteen patients were evacuated to ward 93. Nine patients were moved in beds, five were ambulatory and walked, and one was carried. Smoke spread through ward 91 due to the linen room door being left open, and the open plan design of the ward. The one story, fire resistive medical-surgical building was approximately twenty-two years old. The Anne Arundel County Fire Department responded and verified the fire extinguishment by a staff member with a five pound dry chemical losted extinguisher with a 5A, 10BC rating. The wet pipe automatic sprinkler system also activated from a single ordinary rated head. The fire department also performed salvage and overhaul operations.

Bryan, J. L.; DiNenno, P. J.
Examination and Analysis of the Dynamics of the Human Behavior in the Fire Incident at the Kensington Gardens Nursing Home on January 1, 1978. Final Report.
Maryland Univ., College Park
NBS-GCR-79-159; 67 p. June 30, 1978.
Available from National Technical Information Services PB-290892
chairs; doors; evacuation; fire departments; fire fighters; nursing homes; patients; room fires; smoke; upholstered furniture

The fire incident at the Kensington Gardens Nursing Home on January 1, 1978 was detected by the nursing staff at approximately 9:56 a.m., at which time the fire consisted of preflashover state in patient room 250. The fire apparently originated in an upholstered chair from discarded smoking materials or matches by the room's occupant. The fire consumed the chair, spread to sheets on an adjacent bed, and the privacy curtains hanging between the beds. The fire was confined to the room of origin and did not achieve flashover. The two story building consisted of an original section of ordinary construction, erected in 1937, and a new addition of protected noncombustible construction which was six years old. The fire department was notified at 9:59 a.m. by telephone. Housekeeping and nursing personnel assigned to the second floor, west wing, detected the fire in patient room 250 and immediately closed the door to this fire room. Other patient room doors in the fire zone were then closed, and three patients were evacuated from the fire zone before the corridor became untenable from smoke migration. The housekeeping staff directed arriving fire department personnel up the exterior stairway to the fire zone. The fire department personnel removed four male patients from patient rooms within the fire zone. The seven patients in the fire zone were evacuated by the staff and the fire department in approximately ten minutes from the time of fire detection. The closing of the door to the fire involved room, and the closing of the patient room doors appeared to be critical adaptive actions in this fire incident.

Bryan, J. L.; DiNenno, P. J.
Examination and Analysis of the Dynamics of the Human Behavior in the Fire Incident at the Magnolia Gardens Nursing Home on April 2, 1978.
Maryland Univ., College Park
NBS-GCR-80-211; 43 p. July 31, 1978.
Available from National Technical Information Services PB80-187578
fire departments; fire incident; nursing homes; nursing staff; patients; smoke
The fire incident at the Magnolia Gardens Nursing Home on April 2, 1978 was detected by the nursing staff at approximately 1510 hours. A member of the nursing staff noticed smoke issuing from a ceiling ventilation diffuser in the second floor lounge area. The facility has a capacity of 104 patients and 102 patients were registered at the time of the fire incident. The facility is a two story protected noncombustible construction fully sprinklered building. Upon the detection of the smoke in the second floor lounge area, the ten patients in the area were evacuated through smoke barrier doors to an adjacent area of the second floor. The patients involved were ambulatory or in wheelchairs. The nursing staff then notified the fire department by phone and activated the facility local alarm system. The facility emergency procedures were initiated, the fire department responded and determined the cause of smoke as an electrical motor failure. No smoke detectors or automatic sprinkler heads activated.

Bryan, J. L.; DiNenno, P. J.
Examination and Analysis of the Dynamics of the Human Behavior in the Fire Incident at the Manor Care, Hyattsville Nursing Home on January 10, 1978.
Maryland Univ., College Park
NBS-GCR-80-206; 53 p. June 30 1978.
Available from National Technical Information Services PB80-183221
evacuation; fire department; fire investigations; nursing homes; nursing staff; patients; room fires; sprinkler systems
The fire incident at the Manor Care, Hyattsville Nursing Home on January 10, 1978 was detected by the nursing staff at approximately 2130 hours. The fire at detection involved multiple ignitions, some of which had self-extinguished. A preflashover fire was detected in the bathroom of the patient room of fire origin, room 65. The two-story building of fire resistive construction was approximately 12 years old. At the time of the fire incident the building had a registered occupancy of 126 patients. The fire was confined to the bathroom by staff action and extinguished by the operation of a single automatic sprinkler head. The facility alarm was activated and the fire department notified by telephone calls. The ten nursing staff on duty evacuated a total of ten patients from the fire zone on the terrace level and eight patients from the area above the fire zone in approximately 6.5 minutes, and was completed before the arrival of the fire department. The fire department confirmed extinguishment and performed overhaul and smoke removal operations.

Bryan, J. L.; DiNenno, P. J.
Examination and Analysis of the Dynamics of the Human Behavior in the Fire Incident at the Manor Care, Largo Nursing Home on August 14, 1978.
Maryland Univ., College Park
NBS-GCR-80-223; 36 p. September 30, 1978.
Available from National Technical Information Services PB80-195605
evacuation; fire departments; fire extinguishers; fire investigations; nursing homes; nursing staff; smoke
The fire incident at the Manor Care, Largo Nursing Home on August 14, 1978 was detected by the maintenance engineer at approximately 1100 hours. The fire at detection consisted of flaming in the flue of the incinerator with smoke propagation to the incinerator room and the first floor corridor of the east wing. The two story building of fire resistive construction was approximately two years old. At the time of the fire incident the building had a registered occupancy of approximately 100 patients. Forty patients were evacuated by the nursing staff from the second floor skilled care areas, above the area of fire origin, to the second floor solarium. The fire was contained within the incinerator and extinguished by the

maintenance engineer with a 5 pound all-purpose dry chemical extinguisher immediately prior to fire department arrival. The smoke spread was confined to the first floor east wing area by the smoke barrier doors, with smoke migration to the second floor east wing through minor openings between the first and second floors.

Bryan, J. L.; DiNenno, P. J.
Examination and Analysis of the Dynamics of the Human Behavior in the Fire Incident at the North Arundel Hospital on September 4, 1978.
Maryland Univ., College Park
NBS-GCR-80-224; 29 p. October 31, 1978.
Available from National Technical Information Services PB80-197254
fire investigations; hospitals; nursing staff; bedding; patients
The fire incident at the North Arundel Hospital on September 4, 1978 was detected by a nurse at approximately 1315 hours. The fire at detection consisted of a smoldering propagation with a char area approximately two inches in diameter on the bedspread and blankets covering a sleeping sedated patient. The building in which the fire zone was located was of fire resistive construction, approximately four years old. At the time of the fire incident the building had a registered occupancy of approximately 285 patients. No patients were evacuated or moved in this fire incident. The bedding materials involved were removed from the bed and patient, carried to a utility room and extinguished by dousing with water in a sink. The staff and fire department were not notified, no visible smoke spread occurred, and there were no staff or patient injuries.

Bryan, J. L.; DiNenno, P. J.
Examination and Analysis of the Dynamics of the Human Behavior in the Fire Incident at the Sacred Heart Home, March 19, 1978.
Maryland Univ., College Park
NBS-GCR-80-205; 43 p. July 31, 1978.
Available from National Technical Information Services PB80-183212
evacuation; fire departments; fire investigations; nursing staff; nursing homes; patients; smoke
The fire incident at the Sacred Heart Home on March 19, 1978 was detected by the nursing staff at approximately 1330 hours. The nursing staff was investigating an odor of smoke on the third floor when the fire was detected in patient room 335, with flames issuing from a waste basket to a height of approximately eighteen inches. The facility has a capacity of 102 patients and at the time of the fire incident, had a registered capacity of 101 patients. The facility had the main building of protected noncombustible construction, is approximately forty-two years old and had the north wing of fire resistive construction added approximately 14 years ago. Upon detection of the fire, the nursing staff activated the local alarm system, which automatically transmits a signal to the fire department by a central station system arrangement, and also phoned the fire department. The nursing staff extinguished the waste container fire with water from the sink in room 335, evacuated the one ambulatory patient from room 335 and closed the patient room door. The fire emergency procedures of the facility were initiated by all the staff, the fire department responded and verified the extinguishment. There was reported to be no visible smoke accumulation in patient room 335 or the third floor corridor.

Bryan, J. L.; DiNenno, P. J.
Examination and Analysis of the Dynamics of the Human Behavior in the Fire Incident at the Sligo Gardens Nursing Home on June 10, 1978.
Maryland Univ., College Park
NBS-GCR-80-219; 41 p. August 31, 1978.
Available from National Technical Information Services PB80-191018
doors; evacuation; fire alarm systems; fire extinguishers; fire investigations; nursing homes; nursing staff; television; patients; room fires
The fire incident at the Sligo Gardens Nursing Home on June 10, 1978 was detected by the Second Floor, Nursing Wing charge nurse at approximately 1330 hours. The fire at detection consisted of a flaming power cord to a television set in patient room 228. The two story building of fire resistive construction was approximately ten years old. At the time of the fire incident the building had a registered occupancy to the full capacity of 100 patients. One patient was evacuated by the nursing staff from the room of fire origin without injury. The fire and smoke propagation was limited to room 228 by the closing of the 3/4 hour fire resistive rated doors. The facility local alarm system was activated, the fire department notified and they responded. The fire had been extinguished prior to fire department arrival by nursing staff with a 5 pound all puroose dry chemical extinguisher.

Bryan, J. L.; DiNenno, P. J.
Examination and Analysis of the Dynamics of the Human Behavior in the Fire Incident at the Southern Maryland Hospital Center on January 2, 1979.
Maryland Univ., College Park
NBS-GCR-80-232; 33 p. February 28, 1979.
Available from National Technical Information Services PB80-207343
fire departments; fire extinguishers; fire investigations; hospitals; nursing staff; smoke; smoke detectors
The fire incident at the Southern Maryland Hospital Center on January 2, 1979 was detected by a patient at approximately 0001 hours. The male patient in the psychiatric care unit on the fourth floor, west wing, reported to a nurse at the nurses station that there was an odor of smoke in the south corridor outside the closed

door of vacant patient room 414. The nurse immediately initiated the facility fire emergency procedures with a phone call to the facility telephone operator. The telephone operator alerted the facility with a verbal "Code Red" an anouncement over the public address system and phoned the Prince George's County Fire Communications Center on the "911" emergency number. The fire in a fiber glass waste container was extinguished by a male psychiatric patient using a 10 pound, listed all purpose dry chemical extinguisher, rated 5A, 60B, C. The smoke propagation was heavy in room 414, and moderate in the south corridor of the fourth floor, west wing. The smoke was confined to the east wing area by the smoke barrier doors. The smoke detector system in the psychiatric care unit, including room 414, activated immediately following extinguishment. The seventeen patients in the psychiatric care unit were all ambulatory and were evacuated to the fourth floor, east wing, following extinguishment for the duration of the night. The five- and two-story building of fire resistive construction was approximately thirteen months old. At the time of the fire incident, there were 17 patients in the 25 bed capacity psychiatric unit.

Bryan, J. L.; DiNenno, P. J.
Examination and Analysis of the Dynamics of the Human Behavior in the Fire Incident at the St. Annes Infant Home on June 20, 1978.
Maryland Univ., College Park
NBS-GCR-80-221; 26 p. September 30, 1978.
Available from National Technical Information Services PB80-197262
evacuation; fire departments; fire extinguishers; fire investigations; nursing homes; nursing staff; smoke
The fire incident at the St. Annes Infant Home on June 20, 1978, was detected by the administrator at approximately 2015 hours. The fire at detection involved the overheating of electrical switch gear, which produced a white-colored smoke, completely filling the boiler room in the basement. The four-story and basement building of fire resistive construction was erected approximately 15 years ago. At the time of the fire incident, the facility had an occupancy of 79 children and 15 mothers. The fire was confined to the overheated electrical switch gear, with no visible flames, and smoke limited to the boiler room, the area of fire origin. The fire department was notified and responded. No residents were moved within the facility or evacuated from the facility. The staff action of turning off the electrical power stopped the overheating, and closing of the boiler room door confined the smoke.

Bryan, J. L.; DiNenno, P. J.
Examination and Analysis of the Dynamics of the Human Behavior in the Fire Incident at the University Nursing Home on April 13, 1979. Final Report.
Maryland Univ., College Park
NBS-GCR-80-191; 36 p. January 1980.
Available from National Technical Information Services PB80-158157
death; doors; egress; evacuation; fire alarm systems; fire department; fire fighters; flashover; nursing homes; nursing staff; patients;room fires; smoke detectors
At approximately 0833 hours on April 13, 1979, the smoke detector located on the ceiling of the lounge area at the south end of the corridor of the South Section of B wing on the second floor activated in the University Nursing Home, 901 Arcola Avenue, Silver Spring, Maryland. This detector was activated by a flow of convected heat and dark smoke from the door of patient room 27 fifteen feet to the North. The activation of this smoke detector automatically initiated the activation of the local alarm system. The receptionist upon hearing the alarm notified the Montgomery County Emergency Operations Center. The nursing staff were able to close the doors to all the patient rooms in both the South and West Sections of B wing with the exception of the door to the room of fire origin, room 27. The room experienced flashover and the rapidly spreading heat and smoke forced the staff out of the area. The smoke barrier doors closed with the activation of the local alarm system and prevented the spread of smoke extensively to the West Section and in particular to A wing. Approximately 21 patients were removed from rooms in the South Section by the fire department, 7 of these down ladders. An additional 26 patients were evacuated from the West Section of B wing. Seventeen patients were transported to hospitals for medical treatment with eight staff members. Two of these patients subsequently died. The total fire department response involved three alarms. The fire was extinguished within 5 minutes of the arrival of the first engine and within 9 minutes of smoke detector activation.

Bryan, J. L.; DiNenno, P. J.
Examination and Analysis of the Dynamics of the Human Behavior in the Fire Incident at the Washington Adventist Hospital on December 22, 1978.
Maryland Univ., College Park
NBS-GCR-80-231; 31 p. January 31, 1979.
Available from National Technical Information Services PB80-207905
doors; evacuation; fire extinguishers; fire investigations; hospitals; nursing staff; patients; smoke
The fire incident at the Washington Adventist Hospital on December 22, 1978 was detected by a staff employee at approximately 1028 hours. The fire at detection consisted of a plastic food tray, with plastic containers and paper combustibles on an energized hot plate in the clean utility room of nursing unit 2200 on the second floor. At detection, flames had achieved a height of approximately 24 inches and a dense black layer of smoke had accumulated 18 inches in depth at the ceiling of the room of origin. The six story building of fire resistive construction was approximately twenty-eight years old. At the time of the fire incident this hospital had a registered occupancy of 360 patients. Two patients were evacuated

from the corridor adjacent to the room of origin, and one patient from a room across the corridor by the nursing staff. The fire and smoke propagation was limited to the clean utility room by the closing of the 20 minute fire resistive rated door. The hospital local alarm system was activated, the hospital fire brigade and the fire department were notified. The fire was extinguished by a physcian and nusing staff personnel with a pitcher of ice water and a 2-1/2 gallon pressurizd water extinguisher prior to fire department arrival. The fire department verified extinguishment and conducted overhaul and ventilation operations.

Bryan, J. L.; DiNenno, P. J.
Examination and Analysis of the Dynamics of the Human Behavior in the Kitchen Fire Incident at the Manor Care, Adelphi Nursing Home on March 1, 1978.
Maryland Univ., College Park
NBS-GCR-80-207; 42 p. July 31, 1978.
Available from National Technical Information Services PB80-185739
fire extingushers; fire investigations; kitchen fires; nursing homes
The fire incident in the kitchen at the Manor Care, Adelphi Nursing Home on March 1, 1978 was detected by the cook at approximately 0615. The fire at the time of detection consisted of grease burning on the side of the stove with light smoke and flames approximately eighteen inches high. The two story building of five resistive construction was approximately ten years old. At the time of the fire incident, the building, with a capacity for 210 patients, had a registered occupancy of 185 patients. The cook extinguished the fire with a ten pound all purpose listed dry chemical extinguisher. The local alarm system of the facility was not activated, the fire department was not notified, and since patients were not in the fire zone, no evacuation was initated.

Bryan, J. L.; DiNenno, P. J.
Human Behavior in a Nursing Home Fire.
Maryland Univ., College Park
Fire Journal, Vol. 74, No. 3, 44-47,141-143, May 1980.
human behavior; nursing homes; nursing staff; fire departments; smoke; flashover; fire alarm systems
University Nursing Home was a two-story building of protected, noncombustible construction, located in Silver Spring, Maryland. At approximately 8:33 am on April 13, 1979, a smoke detector on the ceiling of a lounge area at the south end of the corridor in the south section of B wing on the second floor of the nursing home activated. This detector was activated by a flow of convected heat and dark smoke from the door of patient room 27, approximately 15 feet to the north.

Bryan, J. L.; DiNenno, P. J.; Milke, J. A.
Determination of Behavior Response Patterns in Fire Situations, Project People II. Final Report--Incident Reports August 1977-June 1980.
Maryland Univ., College Park
NBS-GCR-80-297; 234 p. August 31, 1980.
Available from National Technical Information Services PB81-224545
doors; evacuation; fire alarm systems; fire departments; fire extinguishers; fire investigations; hospitals; nursing homes; nursing staff;smoke; smoke detectors; sprinkler systems
This report is a summary and initial analysis of the sixty-five fire incidents included in the study population of Project People II. The fire incidents have been analyzed to present in tabular form the descriptive characteristics of the facilities with the construction, interior finish, and fire zone features shown. Staff and fire department behavioral actions were summarized and are presented in another table, with the number of persons evacuated, the means of evacuation table, with the number of persons evacuated, the means of evacuation, the extinguishment behavior, the closing of doors and the ventilation of smoke through the facility windows. The fire protection features of the facilities are presented in a third table. The sixty-five fire incidents included in this summary occurred between August 10, 1977 and June 25, 1980. The facilities involved in the incidents have primarily been health care facilities in accordance with the objective of the research study, with twenty-five nursing home or convalescent center and thirty-three hospital incidents. In addition, two schools, two high rise apartments, two university dormitories and one correctional institution fire incidents were included due to the extensive evacuation behavior. The abstract of each fire incident report is presented with the diagrams of the maximum fire and smoke development in the realms and the movements of personnel in the survey of the facility and interviews with critical fire department, staff and patient personnel.

Bryan, J. L.; Milke, J. A.
Determination of Behavior Response Patterns in Fire Situations, Project People II. Final Report. Health Care.
Maryland Univ., College Park
NBS-GCR-81-343; 304 p. October 1981.
Available from National Technical Information Services PB82-136771
doors; evacuation; fire alarm systems; fire departments; fire extinguishers; fire investigations; hospitals; nursing homes; nursing staff; smoke; smoke detectors; sprinkler systems
This study involved the detailed investigation of 59 fire incidents in Health Care Facilities located in the State of Maryland, with one facility in Philadelphia. A total of 150 staff participants, 9 patients and 53 fire department personnel were interviewed relative to the fire and smoke

development during the fire incident, and the human behavior responses of the participants during the fire incident. The analysis and study of the fire incident and interview data enabled the examination of the parameters of the fire incident including: area of fire origin, ignition and fuel characteristics, and the fire protection design features of the building. The human behavior variables of the fire incidents relative to the means of becoming aware of the fire incident, and the first three actions of the participants were compared to the variables of the fire and smoke development, previous training and fire experience of the participants, and with their belief in the safety of the building. Statistical analyses were performed indicating the relationships among the variables. The evacuation behavior was studied with the sequences of the actions adopted by the personnel.

Bryan, J. L.; Milke, J. A.
Examination and Analysis of the Dynamics of the Human Behavior in the Fire Incident at the Hidden Brook Treatment Center on February 15, 1979.
Maryland Univ., College Park
NBS-GCR-80-238; 32 p. August 31, 1979.
Available from National Technical Information Services PB80-209059
evacuation; fire departments; fire investigations; nursing staff; patients; smoke; smoke detectors
This fire incident was detected at approximately 2330 by the activation of a smoke detector in the first floor corridor and the concurrent activation of the local alarm system. The nursing staff of three persons and one visitor directed and assisted the thirty-five ambulatory patients from the building in approximately seven minutes. The fire was initiated in the first floor lounge of the four-story protected ordinary constructed building. The spread of fire within the lounge was initiated by fire retardant treated wall paneling. The vertical spread of flames and heat up the west stairway was limited by the one hour fire resistant rated door at the first floor. The spread of smoke was limited to a light accumulation in the patient occupied areas, even though dense smoke was observed in the first floor lounge, due to the effective operation of the corridor smoke barrier doors. The Harford County Communications Center was immediately notified by the staff. The Bel Air Volunteer Fire Department responded and extinguished the fire with one 1-1/2 inch hose line within 15 minutes of the activation of the detector, confining the fire to the area of origin, the first floor lounge. The fire department also performed ventilation, overhaul and salvage operations.

Bryan, J. L.; Milke, J. A.
Examination and Analysis of the Dynamics of the Human Behavior in the Fire Incident at the Pikesville Nursing and Convalescent Center on February 8, 1979.
Maryland Univ., College Park
NBS-GCR-80-236; 29 p. August 31, 1979.
Available from National Technical Information Services PB80-204985
fire departments; fire investigations; nursing homes
This fire incident at the Pikesville Nursing and Convalescent Center on February 8, 1979 was initially detected by a laundress entering the laundry room. The laundress turned off the washing machine and also manually tripped the circuit breaker immediately after detection, which resulted in the extinguishment of the fire. The laundress then called the desk receptionist to initiate the facility emergency procedures and to notify the Baltimore County Fire Department. Patient room doors were closed by staff personnel and no patients were evacuated during this fire incident. Damage was limited to clothing inside the washing machine located in the basement of this two-story, 8-year-old facility of protected non-combustible construction. The Baltimore County Fire Department responded and verified extinguishment.

Bryan, J. L.; Milke, J. A.
Examination and Analysis of the Dynamics of the Human Behavior in the Fire Incident at the Union Hospital of Cecil County on July 29, 1979.
Maryland Univ., College Park
NBS-GCR-80-261; 25 p. November 30, 1979.
Available from National Technical Information Services PB80-218084
fire departments; fire investigations; hospitals; smoke; smoke detectors
This fire incident at the Union Hospital of Cecil County on July 29, 1979 was initially detected by a pharmacy technician who perceived a smoke odor in the pharmacy on the first floor at approximately 1212 hours. The pharmacy technician immediately phoned the facility operator who initiated the facility fire emergency procedures with the public address system announcement and notified the fire department. The pharmacy technician and the laundry supervisor located the source of the smoke emitting from an exhaust duct in the linen finishing room on the first floor. Damage was limited to the duct in the finishing room and light smoke damage first floor area in the six-story, fire-resistive, nine-year-old building. Patients were protected in their rooms behind closed doors. The fire self-extinguished following the smoke detector activation of dampers in the duct. Ventilation of the first floor area with fans and over-haul procedures was performed by the Elkton and North East, Maryland Fire Departments with the Christinia and Newark, Delaware Volunteer Fire Departments.

Bryan, J. L.; Milke, J. A.
Examination and Analysis of the Dynamics of the Human Behavior in the Fire Incident at the Wilson Health Care Center on June 25, 1980.

Maryland Univ., College Park
NBS-GCR-80-277; 50 p. July 31, 1980.
Available from National Technical Information Services PB80-224934
fire departments; fire extinguishers; fire investigations; mattresses; nursing homes; nursing staff; room fires; sprinkler systems
A series of three fires occurred in the Wilson Health Care Center, 301 Russell Avenue, Gaithersburg, Maryland in the early morning hours of June 25, 1980. The fires were all of undetermined, suspicious origin and all occurred in patient room 239, located on the second floor of the southwest wing. The Wilson Health Care Center is a portion of the Asbury Methodist Home Complex. The building of fire resistive construction was initially constructed in 1973 and the southwest wing involved in these fire incidents was constructed in 1980. The southwest wing is protected with combination smoke detectors and door closers on the patient room doors, wet pipe sprinkler system (7) class III standpipe system (11) smoke barrier doors in the corridors and extinguishers distributed according to standard partice.

Bryan, J. L.; Milke, J. A.; DiNenno, P. J.
Examination and Analysis of the Dynamics of the Human Behavior in the Fire Incident at the Sheppard and Enoch Pratt Hospital on April 5, 1979.
Maryland Univ., College Park
NBS-GCR-80-241; 32 p. July 31, 1979.
Available from National Technical Information Services PB80-207236
beds (furniture); evacuation; fire departments; fire extinguishers; fire investigations; hospitals; patients
The fire incident at the Shepard and Enoch Pratt Hospital on April 5, 1979 was detected by a patient at approximately 0721 hours. The fire at detection consisted of the blankets, linen and top surface over three-fourths of the area of a single bed in room 110 of wing 1-E of the Chapman Building. The fire was reported by phone to the facility operator who initiated the "fire call" announcement on the public address system and notified the Baltimore County Fire Department. The approximately twenty ambulatory patients on the wing at the time of the fire were evacuated initially through the smoke barrier door to the stairway and eventually to the second floor of the building. The fire was extinguished by staff and the facility fire brigade, expending fifteen 5-pound dry chemical listed extinguishers with a 5A, 10BC rating. The fire department responded, verified extinguishment and performed salvage and overhaul operations.

Fire

Fire
Corner Questions Decision Not to Have Smoke Detectors in Fatal Fire Hospital.
Fire, Vol. 74, No. 921, 521, March 1982.
smoke detectors; hospitals

Fire Chief

Fire Chief
Nursing Home Saved.
Fire Chief, Vol. 21, No. 12, 32, December 1977.
nursing homes; fire detection; training; evacuation; patients

Koffel, W. E.

Koffel, W. E.
Detectors and/or Sprinklers in Residential and Institutional Occupancies? Sprinklers Are Sufficient.
Koffel Associates, Inc., Ellicott City, MD
Building Official and Code Administrator, Vol. 23, No. 3, 34-35,37-38, May/June 1989.
fire detectors; sprinkler systems; fire codes; effectiveness; health care facilities; bedrooms

Koffel, W. E.
Estimating the Effectiveness of State-of-the-Art Detectors and Automatic Sprinklers on Life Safety in Health-Care Occupancies.
Koffel Associates, Inc., Ellicott City, MD
Pacific Rim Conference of Building Officials Proceedings. April 9-13, 1989, Honolulu, HI, Intl. Conf. of Building Officials, Whittier, CA, 175-188 pp, 1989.
health care facilities; effectiveness; building codes; fire detectors; sprinklers; life safety; smoke detection; qualitative analysis; fire tests

Koffel, W. E.
Estimating the Effectiveness of State-of-the-Art Smoke Detectors and Automatic Sprinklers on Life Safety in Hospitals. Technical Document Series.
Koffel Associates, Inc., Marriottsville, MD
Technical Document 055894; 38 p. July 1987.
fire safety; smoke detectors; sprinklers; life safety; hospitals

Koffel, W. E.
Health Care Facilities--Do Sprinklers and Detectors Save Lives?
Koffel Associates, Inc., Ellicott City, MD
Fire Protection, Vol. 17, No. 1, 6-8,10-12, March 1990.
health care facilities; sprinklers; fire detection systems; life safety; hospitals; fire statistics; response time; large scale fire tests; smoke detectors

Koffel, W. E.
Smoke Detectors in Patient Rooms: Two Views of the Same Proposal...And Against the Proposal.
Koffel Associates Inc., Marriotsville, MD
Fire Journal, Vol. 81, No. 5, 21,114, September/October 1987.
smoke detectors; health care facilities; hospitals

Meland, O.

Meland, O.; Skaret, E.
Smoke Control in Hospitals.
SINTEF, River and Harbour Lab.
Norwegian Inst. of Technology
Fire Technology, Vol. 22, No. 1, 33-44, Feb. 1986.
smoke control; ventilation; smoke detectors; smoldering; large scale fire tests

Mortimer, A.

Mortimer, A.
Dorset Hospital's "Intelligent" Detection System.
Autronica Industrial Ltd., England
Fire, Vol. 77, No. 952, 26-27, October 1984.
hospitals; fire detection systems; escape means; false alarms

Neibauer, L. L.

Neibauer, L. L.
Detectors and/or Sprinklers in Residential and Institutional Occupancies? Both Are Necessary.
Automatic Fire Alarm Association
Building Official and Code Administrator, Vol. 23, No. 3, 34-36, May/June 1989.
fire detectors; sprinkler systems; fire codes; smoke detectors; hotels; life safety

O'Neill, J. G.

O'Neill, J. G.
Brief Status Report on NBS/CFR Sprinkler Projects.
National Bureau of Standards, Gaithersburg, MD
National Fire Prevention and Control Administration. Conference on Low Cost Residential Sprinkler Systems. November 29-20, 1977, 16 pp, 1977.
sprinklers; health care facilities; stairways
The National Bureau of Standards/Center for Fire Research, Program for Fire Detection and Control Systems, is presently engaged in two major sprinkler research projects. The first is a study of automatic sprinklers in health care facilities, and the second is a study of sprinkler and spray methods for the protection of open or partially open stairways. This is a brief report on the status as of November 1977. Full technical information will be presented in final reports when projects are completed.

Palmer, K.

Palmer, K.
Fire Protection in Health Care Premises.
Fire Research Station, Borehamwood, England
Fire Prevention, No. 209, 27-31, May 1988.
hospitals; mattresses; bedding; fire detection systems; sprinkler systems; upholstered furniture

Pearce, N.

Pearce, N.
Fire Alarm Systems in Health Care Premises.
Fire Surveyor, Vol. 15, No. 2, 12-17, April 1986.
health care facilities
The automatic fire detection system in a health care building has three prime functions. Briefly, its purpose is to detect a fire and to sound the alarm while at the same time summoning the fire brigade. Unfortunately the performance of many installed systems leaves a lot to be desired. In this article the author describes some of the main requirements of a hospital fire alarm system, and draws attention to some of the deficiencies and limitations of the systems we live with at the moment. A few areas where so called 'new generation' systems might improve matters are highlighted. The opinions expressed in this article are those of the author and necessarily those of the DHSS.

Todd, C.

Todd, C.
Fire Safety in Health Care Premises.
Society of Fire Protection Engineers, UK
Fire Surveyor, Vol. 18, No. 1, 33-40, Feb. 1989.
health care facilities; fire safety; fire tests; sprinklers; fire detection; training

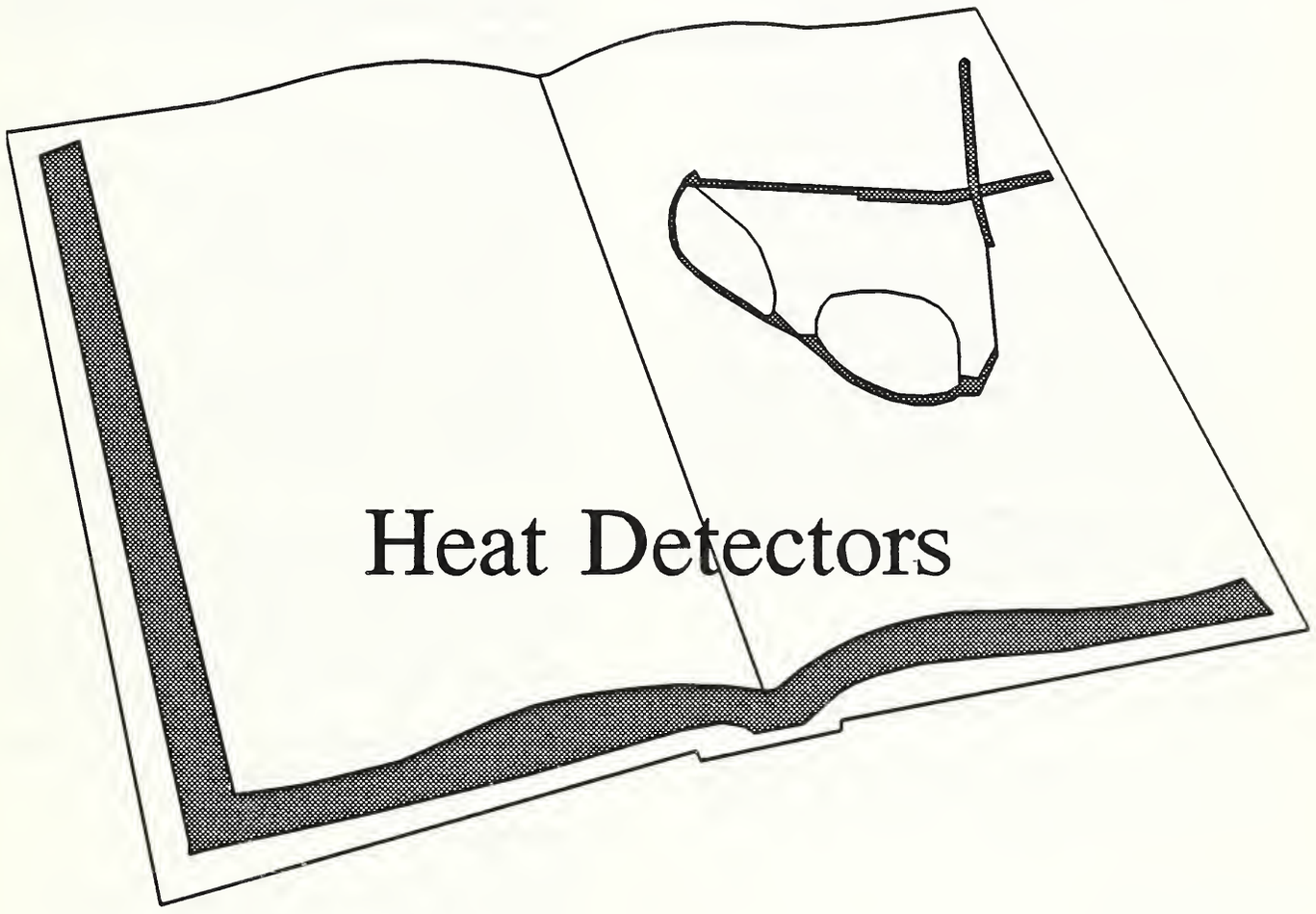
Wagstaff, T.

Wagstaff, T.
Detection Systems for Hospitals and Residential Care Premises.
Fire Surveyor, Vol. 13, No. 2, 4-7, August 1984.
fire detectors; hospitals; fire safety; residential buildings; fire alarm systems
Too often automatic fire alarm and detection systems are provided simply to fulfill a Code requirement. Hence, there is little incentive to attempt to match the system to the functional requirements of the building. Health care premises, by the very nature of their occupants, cannot be equated to other public buildings and their evacuation and fire policies reflect these differences. The fire alarm and

detection systems, if they are to be effective, should be designed to augment these policies. This article puts forward the special fire detection and alarm needs of hospitals and residential care premises.

Wagstaff, T.
Fire Alarms in Health Care Premises.
Department of Health and Social Security, London, England
Coventry Area Health Authority. Fire Safety in Health Care Buildings. November 6, 1980, Coventry, England, 65-77 pp, 1980.
health care facilities; fire alarm systems; fire detection

International Fire Detection
Bibliography 1975-1990



Heat Detectors

This section contains a small number of papers, none of which present any new material. Most are review articles containing similar descriptions of the operating principles of current devices. The only paper of note describes the performance characteristics of a German pneumatic tube system [Luck *et al* 1986].

Brooks, J. L.

Brooks, J. L.
Heat-Activated Alarm System for Railroad Boxcars Carrying Explosives. Final Report. October 1974-September 1977.
Civil Eng. Lab (Navy), Port Hueneme, CA
CEL-TN-1512; 27 p. December 1977.
Available from National Technical Information Services AD/A-051868
railroads; temperature warning system; explosives; transportation; safety; friction; heat; fire safety; heat detectors
An alarm system concept designed to alert train operators of excessive heating of any of the wheels of a boxcar laden with high-explosives has been developed. The excessive heat was determined to be caused by friction between a wheel and brake shoe that does not properly release while the train is in motion. The alarm system consists of heat sensors that are located on the boxcar above each wheel. These are wired to an alarm transmitter mounted near the top of the boxcar. This concept requires that each boxcar laden with high explosives be outfitted with the sensors and a transmitter. A receiving system is then located in the train caboose to decode the alarm signals, identify the boxcar, and sound the alarm. The system hardware, tests, and evaluation are described.

Burry, P.

Burry, P.
Principles of Fire Detection. Part 2. Heat Detectors.
Fire Research Station, Borehamwood, England
Fire Surveyor, Vol. 9, No. 6, 21-27, Dec. 1980.
heat detectors; fire detection

Drysdale, D. D.

Drysdale, D. D.
Mechanisms of Fire Detection.
Edinburgh Univ., Scotland
University of Edinburgh. Recent Developments in Fire Detection and Suppression Systems. (With Additional Papers
From a Course of the Same Title--July 8-9, 1987). November 10-12, 1986, Edinburgh, Scotland, 11 pp, 1987.
fire detection; flame detectors; heat detectors; smoke detectors

Lathrop, J. K.

Lathrop, J. K.
Dwelling Fire Kills Three Despite Heat Detectors.
National Fire Protection Assoc., Quincy, MA
Fire Journal, Vol. 72, No. 5, 120-122, Sep. 1978.
heat detectors; residential buildings; death; single family dwelling

Luck, H. O.

Luck, H. O.; Deffte, N.
Dynamic Performance of Pneumatic Tube Type Heat Sensitive Fire Detectors.
Duisburg Univ., West Germany
International Association for Fire Safety Science. Fire Safety Science. Proceedings. 1st International Symposium.
October 7-11, 1985, Gaithersburg, MD, Hemisphere Publishing Corp., NY, Grant, C. E. and Pagni, P. J., Editors, 729-737 pp, 1986.
fire detectors; heat detectors

Newman, J. S.

Newman, J. S.
Principles for Fire Detection.
Factory Mutual Research Corp., Norwood, MA
Fire Technology, Vol. 24, No. 2, 116-127, May 1988.
fire detection; response time; enclosures; heat detectors; compartment fires; heat release rate

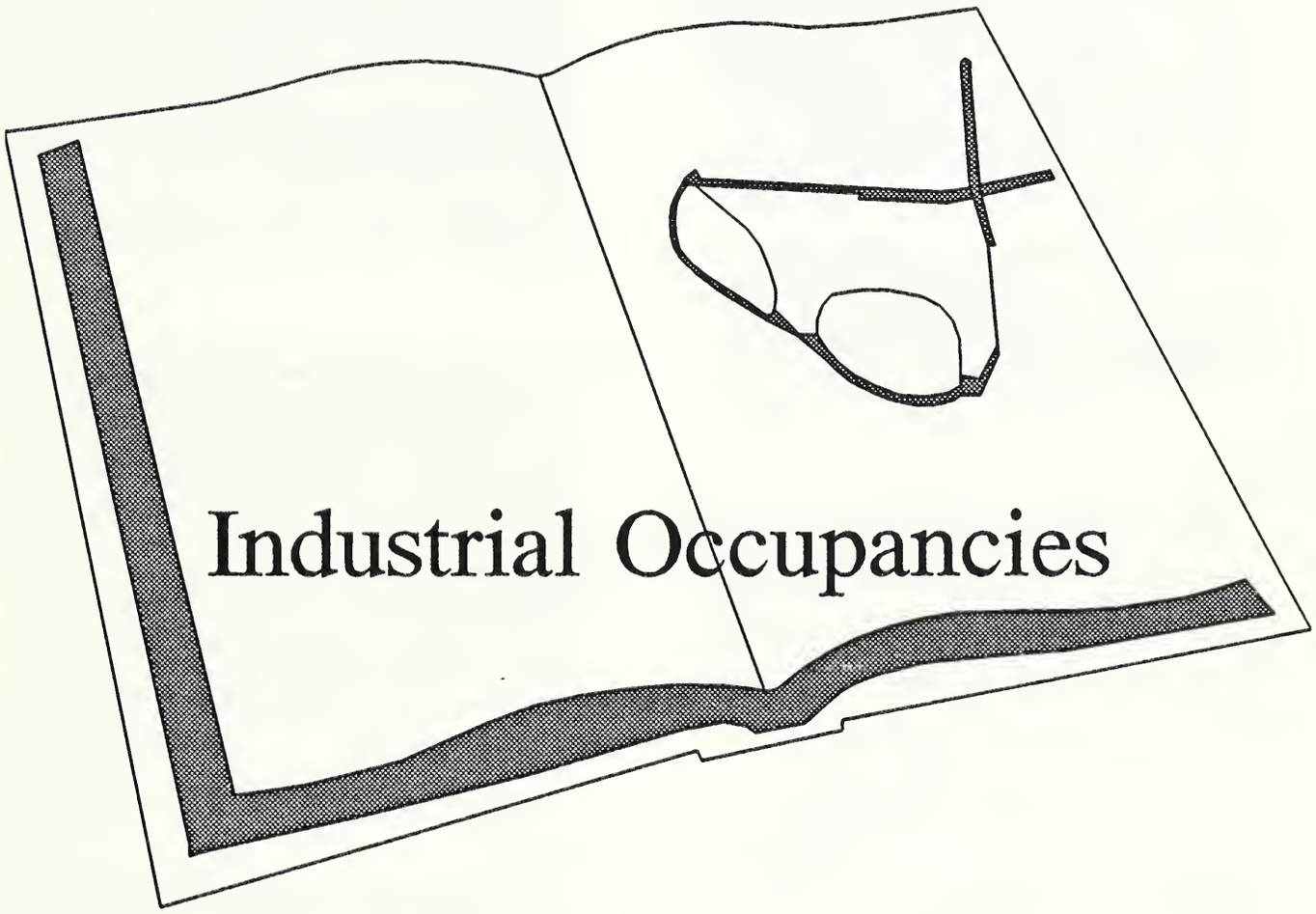
Takemoto, A.

Takemoto, A.
Response Characteristics of Heat Detectors.
Fire Research Institute, Tokyo, Japan
UJNR Panel on Fire Research and Safety. 8th Joint Panel Meeting. May 13-21, 1985, Tsukuba, Japan, 763-779 pp, 1985.
heat detectors

Thorpe, R. F.

Thorpe, R. F.
New Concept in Heat Detector Design.
Falcon Safety Products, Inc.
Fire Journal, Vol. 71, No. 2, 69-71, 96, Mar 1977.
heat detectors; design applications; fire protection

International Fire Detection
Bibliography 1975-1990



Industrial Occupancies

The papers in this topic are all related to the application of current technology detectors to various industrial hazards. The information provided represents an excellent overview of current concepts of industrial protection practice for a broad range of applications. While dominated by power plants (both nuclear and non-nuclear) and petrochemical operations, discussion of protection techniques for libraries and historic buildings, anechoic chambers, storage, ammunition plants, telephone facilities, offices, textile mills, highway tunnels, underground structures, and peat boiler plants can be found. Thus, these papers should provide an overview of the state-of-the-art in industrial protection.

American Petroleum Institute

American Petroleum Institute
Fire Prevention and Control on Open Type Offshore Production Platforms. Recommended Practice. 1st Edition.
American Petroleum Institute, Dallas, TX
API RP 14G; 26 p. September 1978.
offshore platforms; ignition source; fire prevention; fire detection systems; fire suppression; fire extinguishment; maintenance; safety
This RP presents recommendations for minimizing the likelihood of having an accidental fire, for designing, inspecting and maintaining fire control systems and emphasizes the need to train personnel in fire fighting, routine drills and methods for safe evacuation.

Anderson, C.

Anderson, C.; Celt, J. M.; Phillips, J.
Spectrum of Optical Fire Detection.
Detector Electronics Corp., Minneapolis, MN
Detector Electronics, UK
BHRA, The Fluid Engineering Center; Society of Fire Protection Engineers; Safety and Reliability Directorate of UKAEA and Institution of Chemical Engineers. Fire Engineering in Petrochemical and Offshore Applications. International Conference Proceedings. June 23-24, 1987, Paper C1, Stratford-upon-Avon, England, 39-41 pp, 1987.
fire detection; offshore platforms; industrial plants; ultraviolet detectors; infrared detectors

Benzenberg, G. E.

Benzenberg, G. E.
Overview of Line-Type Fire Detectors.
Alison Control Inc., Fairfield, NJ
Plant Engineering, Vol. 40, No. 14, 52-53, July 10, 1986.
fire detectors; industrial plants; fire protection; temperature measurement; sensors; engineering management; false alarms; maintenance

Boccio, J. L.

Boccio, J. L.; Hall, R. E.; Asp, I.
Acceptance and Verification for Early Warning Fire Detection Systems. Interim Guide.
Brookhaven National Lab., Upton, NY
Gage-Babcock and Assoc., Inc., Mount Kisco, NY
NUREG/CR-1798; BNL-NUREG-51296; NRC FIN No. A-3335; 105 p.
May 1980.
fire detection systems; warning systems; nuclear power plants

British Fire Protection Systems Association

British Fire Protection Systems Association
Fire Detection Systems for the 1990s.
Fire Surveyor, Vol. 19, No. 2, 20-23, April 1990.
fire detection systems; fire alarm systems; office buildings

Cartwright, N. K.

Cartwright, N. K.
Fire Protection at the New British Library.
Steenson Varming Mulcahy Partnership
Fire Prevention, No. 203, 20-24, October 1987.
libraries; fire protection; fire detection systems; building design; exhaust systems

Cerberus

Cerberus
Libraries, Collections and Works of Art: Always at Risk From Fire or Theft.
Fire and Security Engineering, Vol. 5, 1-4, August 1989.
libraries; historic buildings
You don't need a blazing torch nowadays to set a library on fire: in 1986 a small fire in one department destroyed a large part of America's third-largest library: 200,000 volumes were destroyed by the flames, 150,000 were damaged by fire or smoke and a further 600,000 suffered water damage. Furthermore, the most important collection of patents in the western USA was destroyed. Only three months later there was another arson attack on the same library, detroying artistic and musical collections.

Chohan, R. K.
Chohan, R. K.; Upadhyaya, B. R.
Safety and Fault Detection in Process Control Systems and Sensors.
Tennessee Univ., Knoxville
Fire and Materials, Vol. 14, 167-177, Jan. 1989.
safety; accidents; fire protection; explosions; accident prevention; fire alarm systems

Davidson, R. S.
Davidson, R. S.
Smoke, Fire and Gas Detection at British Gas Installations.
Presentation and Discussion.
British Gas plc, England
Communication 1298;
Institution of Gas Engineers. 52nd Autumn Meeting. November 1986, Communication 1298, London, England, 155-159 pp, 1986.
smoke detectors; gas detectors; fire protection; installation; offshore platforms

DiNenno, P. J.
DiNenno, P. J.; Dungan, K. W.
Effectiveness of Fire-Detection Systems in Light-Water-Reactor Facilities.
Professional Loss Control, Inc., Oak Ridge, TN 37830
DE81-029465; ALO-141; 100 p. August 1981.
Available from National Technical Information Services 49-1716
fire detection systems; effectiveness; nuclear reactors

Egilsrud, P. E.
Egilsrud, P. E.
Prevention and Control of Highway Tunnel Fires.
Sverdrup and Parcel, Inc., St. Louis, MO
FHWA/RD-83/032; 136 p. May 1984.
highways; tunnels; hazardous materials; risk analysis; fire prevention
This study investigates steps that can be taken to reduce the risk, damage, and fatalities from fires in existing and future highway tunnels and the effect of unrestricted transit of hazardous materials through them. The history of highway tunnel fires is examined to discover the design and operating features bearing on ignition, spread, detection, alarm transmission, response, control, resulting damage, and survivability aspects. Major domestic highway tunnel operators are interviewed concerning tunnel fires and their responses tabulated and compared. The procedures and results of several tunnel fire tests are examined and their recommendations evaluated in light of historical evidence and operating experience concerning tunnel fires. A risk analysis for unrestricted transit of hazardous materials through a reference tunnel is performed and applied to 35 tunnels included in the study. Qualitative assessments of the effect of traffic, tunnel design, and operations on this risk are made. Comprehensive design and operating recommendations for prevention, detection, alarm notification, contol, extinguishment, suppression, and survival are developed. A ventilation system with a fire/emergency operating mode designed to provide motorists trapped in a tunnel fire with optimal escape potential is described and its inclusion in future vehicular tunnels recommended.

Fire
Fire
Fire Protection Measures in Underground Structures.
Fire, Vol. 69, No. 863, 605-607, May 1977.
structures; fire protection; smoke detectors

Fire Prevention
Fire Prevention
Fire Safety on Oil Rigs.
Fire Prevention, No. 203, 9-10, October 1987.
fire safety; offshore platforms; escape means; fire detection; extinguishing; contamination

Fisher, W. R.
Fisher, W. R.
Protecting Our Treasures From Threat of Fire.
Professional Safety, Vol. 25, No. 2, 21-24, February 1980.
warning systems; fire detectors; fire protection; historic buildings

Green, B. J.
Green, B. J.
Protection in a Nuclear Research Establishment.
Fire International, No. 105, 24-26,29, June/July 1987.
fire detection; fire alarm systems; fire suppression; nuclear reactors

Haffmans, I.
Haffmans, I.
Fire Detectors in Telephone Exchanges.
Technical Center for Fire Prevention TNO, Delft, The Netherlands
University of Duisburg. 8th International Conference on Automatic Fire Detection "AUBE

'82". Probleme der automatischen brandentdeckung. October 5-7, 1982, Duisburg, West Germany, Luck, H., Ed., 440-447 pp, 1982.
fire detection; telephones; fire detectors; fire risks; electronics

Hems, J. P.

Hems, J. P.
Today's Concepts and Design Foam-Water Spray Systems.
Optima Fire Consultants, UK
BHRA, The Fluid Engineering Center; Society of Fire Protection Engineers; Safety and Reliability Directorate of UKAEA and Institution of Chemical Engineers. Fire Engineering in Petrochemical and Offshore Applications. International Conference Proceedings. June 23-24, 1987, Stratford-upon-Avon, England, Paper E3, 87-92 pp, 1987.
water sprays; foam extinguishing systems; design applications; flammable liquids; flammable gases; fire detection; fire extinguishing agents; containment

Ishimoto, W. Y.

Ishimoto, W. Y.
Survey of Commercial Non-Nuclear Security Programs.
SAS of Texas, Ltd., Austin
NUREG/CR-3619; 50 p. March 1984.
Available from National Technical Information Services NUREG/CR-3619
detection; prevention

Joblove, L.

Joblove, L.; Avelar, M.; Dobbs, N.; Frank, L.
Engineering Guide for Fire Protection and Detection Systems at Army Ammunition Plants. Volume 2. Testing and Inspection. Final Report.
Ammann and Whitney, New York, NY
ARRADCOM, Dover, NJ
ARLCD-CR-80049; 190 p. December 1982.
Available from National Technical Information Services AD/B-070350
fire protection; fire detectors; sprinklers; fire extinguishers; fire safety; water supply; fire extinguishing agents; industrial plants;standards; safety; deluge systems; water curtains
This report presents guidelines for testing and inspection of fire protection systems used in Army Ammunition Plants. Existing published standards for fire protection systems are cited and methods applicable to specialized systems are described.

Klapmeier, K. M.

Klapmeier, K. M.
Recent Advances in High Speed Detection Systems for Ammunition Plants.
Detector Electronics Corp., Minneapolis, MN
Minutes of the Explosives Safety Seminar, 21st. August 28-30, 1984, Houston, TX, 627-644 pp, 1984.
Available from National Technical Information Services AD/P-004850
ammunition; explosives; fire detectors; ultraviolet detectors; infrared detectors; military facilities; manufacturing; industrial plants
The author discusses the application of UV detection systems in radioactive environments and the application considerations of infrared, combination infrared, and combinations of ultraviolet and infrared. Recent developments in high speed single frequency infrared detection systems and their applications to munitions processes are also reviewed.

Krasner, L. M.

Krasner, L. M.; Ganti, C. S.; Vincent, B. G.; Samanta, P. K.; Boccio, J. L.
Evaluation of Available Data for Probabilistic Risk Assessments (PRA) of Fire Events at Nuclear Power Plants.
Brookhaven National Laboratory, Upton, NY
NUREG/CR-4231; 68 p. May 1985.
fire hazards; fire data; nuclear power plants; fire detection systems; fire protection
Several crucial parameters are needed in the assesment of fire risk in nuclear power plants. Among those that need to be developed from a data base are: (1) fire frequency, (2) fire detection time, and (3) fire suppression time. Currently, the data base for nuclear power plants is not large enough to develop these parameters, considering fuel location, fuel geometry, combustion properties, enclosure geometry, etc. This study attempts to augment the nuclear data base by investigating the usefulness of other nonnuclear data bases which contain fire incident loss experience of occupancy classes having somewhat similar physical features and fire protection engineering systems normally found in nuclear power plants. This study has found that indeed some useful information can be gleaned from nonnuclear sources; in particular, detection and suppression times. However, other fire-risk data needs such as fire frequency and fire size would require other forms of data searches and data analyses that at this stage can only be conceptualized.

Larsen, T. E.

Larsen, T. E.; Petersen, A. H.
Concept of Offshore Platform Fire Detection.
Detector Electronics Corp., Minneapolis, MN

Automation in Offshore Oil Field Operation. Computer Applications in Shipping and Shipbuilding. Volume 3.
IFAC/IFIP Symposium. June 14-17, 1976, Bergen, Norway,
North-Holland Publishing Co., New York, Galtung, F. L., Rosandhaug, K., Williams, T. J., Editors, 73-75 pp, 1976.
offshore platforms; fire detection; ultraviolet detectors

Levinson, S. H.

Levinson, S. H.; Yeater, M. L.
Methodology to Evaluate the Effectiveness of Fire Protection Systems in Nuclear Power Plants.
Rensselaer Polytechnic Inst., Troy, NY
Nuclear Engineering and Design, Vol. 76, 161-182, 1983.
nuclear power plants; fire protection; ignition; fire detection; fire suppression; fire spread

Linna, V.

Linna, V.
Safe Production and Use of Domestic Fuels. Part 2. Fire Detectors.
Valtion Teknillinen Tutkimuskeskus, Espoo, Finland
VTT-TIED-505; 61 p. October 1985.
Available from National Technical Information Services DE86-752302
fuel oils; power plants; smoke detectors; boilers; combustion; fire prevention; safety; solid fuels; storage
Fire detectors and their suitability to peat boiler plants is considered. The main interest is concentrated on the methods applicable to detection of smouldering fires. The description of fire detection of smouldering fires. The description of fire detection methods is based on the literature and brochure information of the devices. In addition, fire detection and extinguishing systems of three peat boiler plants are described briefly. The conventional smoke detectors are not applicable to detection of smouldering fires in dusty environments. IR spark and flame detectors have been developed intensively during the last years and these are also available to detection of smouldering fires. The improvement of detectors has decreased their sensitivity to false alarms. The present IR detectors are most applicable to spark and fire warning in pneumatic dust coveyor tubes and in dust separators, but these detectors have been used also in association with belt conveyors at peat heating plants.

Loyd, R. A.

Loyd, R. A.
Fire Protection Systems Utilized in United States Army Ammunition Plants (Ultra High Speed Deluge Systems). Final Report.
Army Armament Munitions and Chemical Command Safety Office, Rock Island, IL
Final Report; 49 p. November 30, 1987.
Available from National Technical Information Services AD/A-192447
deluge systems; ammunition; fire protection; hazard analysis; maintenance

Merrick, D.

Merrick, D.
Arctic Halon Systems.
Society of Fire Protection Engineers. Fire Detection and Suppression...Today's Technology. March 9-11, 1987, Linthicum Heights, MD, 1-11 pp, 1987.
Halon 1301; fire suppression; petroleum; fire protection; fire prevention; hazard analysis; systems engineering; instruments; design applications
Design and installation information on Halon 1301 fire suppression systems for Arctic oil production facilities.

Merrick, D.
Fire Protection for Robotics--A Systems Approach. Part 1. Industrial Fire World, Vol. 2, No. 4, 18-21, August 1987.
robotics; fire protection; fire detection

Merrick, D.
Industrial High Technology Fire Protection.
Fire International, Vol. 102, 33-35, December 1986-January 1987.
industrial safety; fire protection; fire detection; fire extinguishment; fire detectors; smoke detectors
With the introduction of high technology equipment comes the need for high technology fire protection. This article examines the problems and suggests a way of tackling them.

Mesley, W. R.

Mesley, W. R.
Fire and Overheat Detection for Conveyor Belt Systems.
Alarmline Ltd.
Fire, Vol. 76, No. 939, 180, September 1983.
fire detection systems; belts conveyors

Potter, C.

Potter, C.
Thinging About Fire. Part 8. Construction and Handover: Checklist for Fire Doors; Furniture Fittings, Furnishings and Fires; Commissioning Fire Protection Services; AJ Fire Index.
Architects' Journal, Vol. 176, No. 42, 89-99, October 1982.
construction; fire doors; fire safety; furniture; fire detection systems; extinguishing; fire protection

Raine, A. J.

Raine, A. J.; Lawrence, A. J.
Detection and Control for a Foam System.
Angus Fire Armour Ltd., UK
GP-Elliott Electornic Systems Ltd., UK
BHRA, The Fluid Engineering Center; Society of Fire Protection Engineers; Safety and Reliability Directorate of UKAEA and Institution of Chemical Engineers. Fire Engineering in Petrochemical and Offshore Applications. International Conference Proceedings. June 23-24, 1987, Stratford-upon-Avon, England, Paper E1, 75-80 pp, 1987.
foam extinguishing systems; flammable liquids; fire detection; fire suppression; safety; fire protection; maintenance

Rittenhouse, R. C.

Rittenhouse, R. C.
Fire: Detection and Prevention at Power Plants.
Power Engineering, Vol. 85, No. 2, 42-50, February 1981.
power plants; fire protection

Ruger, C.

Ruger, C.; Boccio, J. L.; Azarm, M. A.
Evaluation of Current Methodology Employed in Probabilistic Risk Assessment (PRA) of Fire Events at Nuclear Power Plants.
Brookhaven National Lab., Upton, NY
NUREG/CR-4229; 44 p. May 1985.
fire hazards; fire models; nuclear power plants; risk assessment
This report presents a general evaluation of the current methodology used by industry for the probabilistic assessment of fire events in nuclear power plants. The basis for this evaluation, in which the strengths and weaknesses of the methods are identified, stem from reviews of several, industry-sponsored, full-scope Probabilistic Risk Assessments (PRAs) and various deterministic/probabilistic approaches used by industry to judge their compliance with or used to seek exemptions from the fire-protection requirements enumerated in Appendix R to 10 CFR 50. In performing this evaluation of the current methodologies, state-of-the-art literature on the modeling of fire propagation/detection/suppression, input parameters, and modeling uncertainties are utilied. Areas are identified where recently-developed, more accurate and complete techniques can be implemented to reduce the state-of-knowledge uncertainties that presently exist. Recommendations also are made which could be the basis for a more suitable and complete fire-risk methodology.

Siu, N.

Siu, N.; Apostolakis, G.
Modeling the Detection Rates of Fires in Nuclear Plants: Development and Application of a Methodology for Treating Imprecise Evidence.
Pickard, Lowe and Garrick, Inc., Newport Beach, CA
California Univ., Los Angeles
Risk Analysis, Vol. 6, No. 1, 43-59, 1986.
nuclear plants
A model is developed for the detection time of fires in nuclear power plants, which differentiates between competing modes of detection and between different initial fire severities. Our state-of-knowledge uncertainties in the values of the model parameters are assessed from industry experience using Bayesian methods. Because the available data are sparse, we propose means to interpret imprecise forms of evidence to the develop quantitative information, which can be used in a statistical analysis; the intent is to maximize our use of all available information. Sensitivity analyses are performed to indicate the importance of structural and distributional assumptions made in the study. The methods used to treat imprecise evidence can be applied to a wide variety of problems. The specific equations developed in this analysis are useful in general situations, where the random quantity of interest is the minimum of a set of random variables (e.g., in "competing risks" models). The computational results indicate that the competing modes formulation can lead to distributions different from those obtained via analytically simpler models, which treat each mode independently of the others.

Slye, O. M.

Slye, O. M.
Fire Protection on the Beryl A Platform.
Mobile Research and Development Corp.
Fire Journal, Vol. 74, No. 3, 75-77, May 1980.
offshore platforms; fire risks; fire protection; fire detection; fire extinguishing agents

Slye, O. M.
Overview of Applied Research on Hydrocarbon Fire Control.
Loss Control Associates, Inc., Levittown, PA
SFPE Bulletin, No. 87-4, 1,4,7, September 1987.
fire suppression; hydrocarbons; petroleum; industries; fire prevention; fire detection

Taylor, K. T.

Taylor, K. T.
Office Building Fires...A Case for Automatic Fire Protection.
National Fire Protection Assoc., Quincy, MA
Fire Journal, Vol. 84, No. 1, 52-54, January/February 1990.
office buildings; fire protection; fire suppression; fire statistics; fire detection systems

Taylor, K. T.
Temporarily Disconnected.
National Fire Protection Assoc., Quincy, MA
Fire Journal, Vol. 83, No. 3, 24-27, May/June 1989.
telephones; fire detection systems; fire statistics; costs

Textile World

Textile World
Early Detection Stops Fire Before it Starts.
Textile World, Vol. 131, No. 10, 111, Oct. 1981.
industries; fire detection

Thompson, C.

Thompson, C.
Fire Detectors for Offshore Applications--Types and New Developments Described.
Bechtel Ltd., UK
Fire, Vol. 79, No. 978, 39-40, December 1986.
fire detectors; offshore platforms; heat detectors; smoke detectors; flame detectors

Thompson, C. P. A.

Thompson, C. P. A.
Fire Safety Systems for Unmanned Platforms.
Bechtel Ltd., UK
BHRA, The Fluid Engineering Center; Society of Fire Protection Engineers; Safety and Reliability Directorate of UKAEA and Institution of Chemical Engineers. Fire Engineering in Petrochemical and Offshore Applications. International Conference Proceedings. June 23-24, 1987,
Stratford-upon-Avon, England, Paper B2, 25-34 pp, 1987.
offshore platforms; fire safety; regulations; reliability; performance evaluation; design applications; fire detection systems; riskanalysis; water; hazard analysis; fire protection; systems analysis; halons

Thorne, P. F.

Thorne, P. F.
Principles of Fire and Explosion Protection.
Fire Research Station, Borehamwood, England
LA-9911-C-Vol. 1; LA-9911-C-Vol. 2; CSNI No. 83; October 1983.
CSNI Specialist Meeting on Interaction of Fire and Explosion With Ventilation Systems in Nuclear Facilities. Volume 1 and Volume 2. April 25-28, 1983, LA-9911-C-Vol. 1, Los Alamos, NM, 419-434 pp, 1983.
Available from National Technical Information Services DE84-003976-Vol 1 DE84-003977-Vol 2
explosions; combustion; ignition; fire detection systems; flammable gases; vapors; liquids

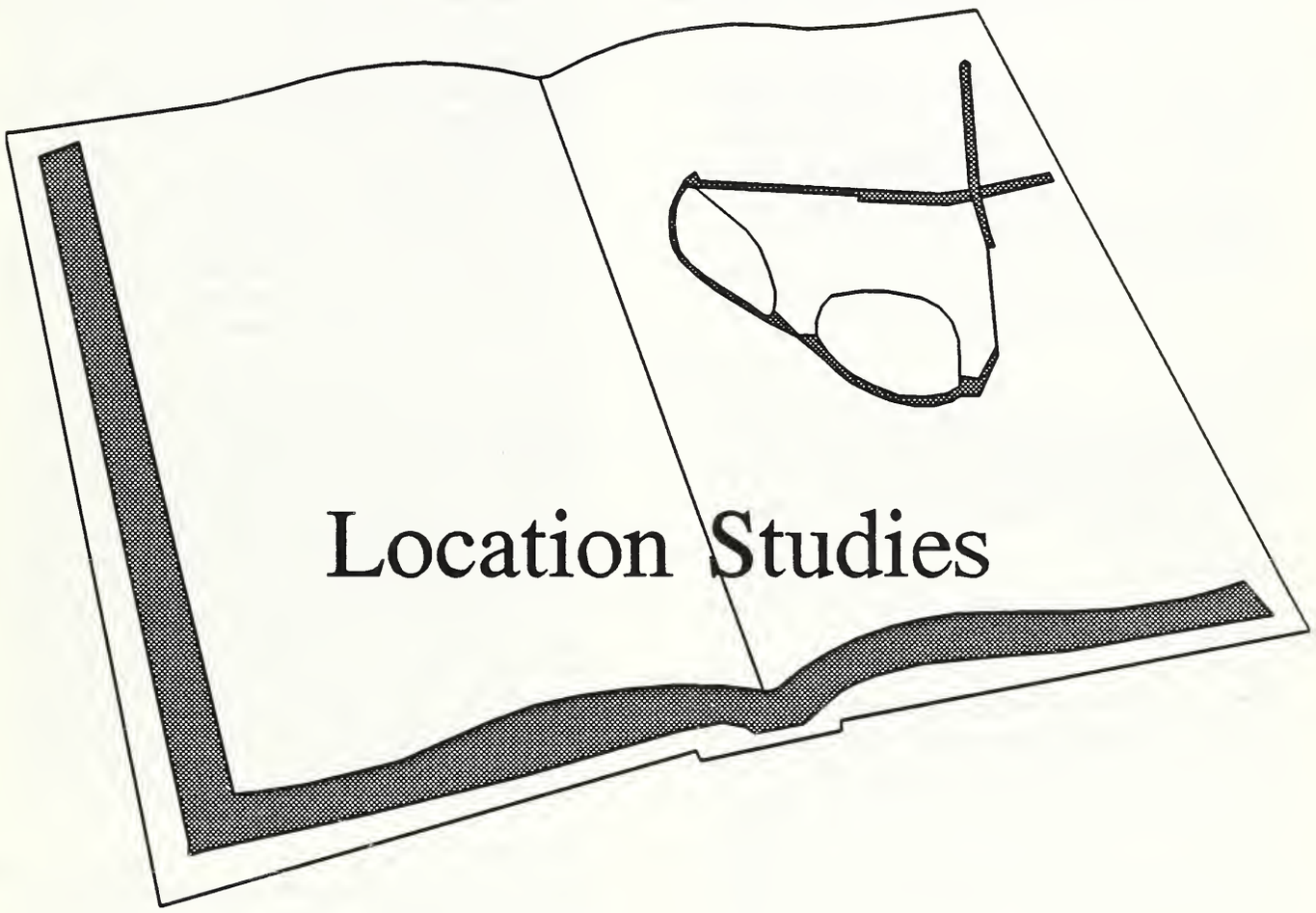
University of Tennessee Space Institute

University of Tennessee Space Institute
Industrial Safety and Fire Protection Appraisal Report.
University of Tennessee Space Institute, Tullahoma
DOE/ET/10815-T6; 12 p. July 18-21, 1988.
Available from National Technical Information Services DE89-003043
industrial safety; fire protection; fire detection systems; fire safety; fire codes

Waterman, T. E.

Waterman, T. E.; Campbell, J. A.; Paarmann, L. D.; Mindel, I. N.; Smoots, C. W.
Evaluation of RF Anechoic Chamber Fire Protection Systems.
Final Report.
Tactical Weapon Guidance and Control Information and Analysis Center, Chicago, IL
GACIAC-SR-80-02; NWC-TP-6211; 170 p. July 1980.
Available from National Technical Information Services AD/A-092478
anechoic chambers; fire resistant materials; fire protection; human performance; fire detectors; fire suppression; flame detectors

The increasing use of microwave anechoic chambers plus several recent chamber fires was the impetus for this special study. The report identifies and collects in one document the various issues and problems associated with the fire protection of anechoic chambers. It also addresses the interfaces between personnel groups including the chamber designers, operators, maintenance and the fire department. It is not a design report: i. e., it does not contain enough detail to design either a chamber or the fire protection system. Instead, it presents the pros and cons of the various fire portection options available to the designers (smoke and heat detectors, alarm systems, sprinkler heads, preferred physical locations, fire suppressant agents, etc.) and relates these to the chamber operation. The report also identifies several areas where additional investigation is required such as detection of deep-seated combustion, testing of new more fire-resistant absorber materials, and analysis of the combustion products of halogen-type suppressants. An extensive list of references is included.



Location Studies

The small number of papers in this category add little new information to this area. Most of the papers deal with detector placement in residences - the occupancy with the least critical placement criteria. Two of the papers deal as much with placement for audibility than with response [Halliwell *et al* 1989 and 1988]. However, several other papers are worthy of special note. One [Kraemer 1989, in German] deals with a computer program which guides the user through placement rules (derived from the standards rather than from a performance model). Another [Matthews *et al* 1985] describes test results examining the interaction of ceiling fans and detector response - a question which comes up regularly since ceiling fans increased in popularity several years ago. An interesting paper [Mniszewski 1980] describes a series of tests conducted for the US General Services Administration on the ability of duct detectors to respond to fires in an adjoining room. There is a discussion of criteria for detector placement in cable spreading rooms [Boccio 1982], and one (unfortunately in Swedish) predicting smoke detector response in rooms with a field model [Vannerberg 1988].

Benjamin, I. A.

Benjamin, I. A.; Heskestad, G.; Bright, R. G.; Hayes, T.
Analysis of the Report on Environments of Fire Detectors.
Fire Detection Institute
35 p. 1979.
fire detectors; smoke detectors

Beyler, C. L.

Beyler, C. L.
Design Method for Flaming Fire Detection.
Worcester Polytechnic Inst., MA
Fire Technology, Vol. 20, No. 4, 5-16, November 1984.
fire detection

Boccio, J. L.

Boccio, J. L.
Requirements for Establishing Detector Siting Criteria in Fires Involving Electrical Materials.
Brookhaven National Lab., Upton, NY
NUREG/CR-2409; SAND81-7168; 51 p. July 1982.
fire detection systems; fire protection; nuclear reactors; electrical cables

Bukowski, R. W.

Bukowski, R. W.
Investigation of the Effects of Heating and Air Conditioning on the Performance of Smoke Detectors in Mobile Home. Final Report.
National Bureau of Standards, Gaithersburg, MD
NBSIR 79-1915; 179 p. October 1979.
Available from National Technical Information Services PB80-100001
detection time; detector location; fire tests; gas detectors; kitchen fires; mobile homes; smoke detectors; tenability limits; upholstered furniture Since its original promulgation in June 1976, the U.S. Department of Housing and Urban Development's Federal Mobile Home Construction and Safety Standard has required the installation of at least one smoke detector to protect the mobile home occupants. The location of the smoke detector was based on earlier tests in a mobile home conducted by NBS in 1976. Because of the limited scope of the earlier NBS tests and subsequent improvements in the design of smoke detectors and the construction of mobile homes, a new series of tests was conducted to evaluate the influences of the operation of central forced-air heating and air conditioning systems on the performance of smoke detectors representative of those which are currently being installed. The tests were conducted with upholstered chairs in smoldering and flaming fire modes, representing key residential fire death scenarios. Tests were conducted in both summer and winter weather conditions. The effects of detector location (wall or ceiling and position within the bedroom corridor) and the effects of open and closed bedroom doors were also investigated. The report concludes that, for the scenarios examined, a properly functioning ionization or photelectric smoke detector mounted near the ceiling on the inside or outside wall at the living room end of the corridor should provide an alarm in sufficient time for occupant escape.

Bukowski, R. W.
Tests on the Performance of Automatic Fire Detectors in Health Care Occupancies--A Preliminary Report.
National Bureau of Standards, Gaithersburg, MD
NBSIR 79-1739; 28 p. April 1979.
Available from National Technical Information Services PB-297150
corridors; escape; fire detectors; large scale fire tests; heat detectors; hospitals; ionization detectors; mattresses; nursing homes; photoelectric detectors
The paper reports the results of the first series of eight full-scale fire tests to evaluate the response of automatic fire detectors in health care occupancies to flaming ignition mattress fires. Comparisons were made between three types of detectors (ionization, photelectric, and heat)

installed in the patient room versus in the corridors. For the fire scenario selected (flaming igniton of bedding and mattress), the results indicated that the ionization-type detectors in the patient room provided the maximum time for escape. The maximum time period available for either rescue of an non-ambulatory patient in the room of origin or for use of the corridor past the room of origin as a means of escape averaged only about five minutes. The time available for escape or rescue were based on the time provided between detector alarm and the time that one of several criteria selected for occupant tenability was exceeded.

Evans, D. D.

Evans, D. D.; Morehart, J.
Investigation of the Effects of a Stratified Two Layer Environment on Fire Plume Temperatures.
National Bureau of Standards, Gaithersburg, MD
California Institute of Technology, Pasadena, CA
American Society of Mechanical Engineers and Japan Society of Mechanical Engineers.
Proceedings of the 1987 ASME-JSME Thermal Engineering Joint Conference. Volume 1.
March 22-27, 1987, Honolulu, HI, American Society of Mechanical Engineers, New York, Marto, P. and Tanasawa, I., Eds., 381-386 pp, 1987.
fire plumes; high temperature gases
A layer of gas at elevated temperature accumulates below the ceiling of a room during a fire. This layer affects fire plume and ceiling jet flows, heat transfer to the ceiling material, and ultimately detector (suppression system) response time. This paper experimentally examines the effects of a stratified warm gas layer on plume flow temperatures originating from a source located in an ambient lower layer. Measurements of spatial distributions of temperature at steady state are presented for a confined 1.2 m diameter cylindrical ceiling configuration. Encouraging agreement is found between experimental temperature measurements and predictions by two existing models for describing temperatures in this two layer environment.

Gawin, W. M.

Gawin, W. M.
Mobile Home Smoke Detector Siting Study. Final Report.
National Bureau of Standards, Gaithersburg, MD
NBSIR 76-1016; 54 p. May 1976.
Available from National Technical Information Services PB-254177
fire detectors; photoelectric detectors; detector sensitivity; mobile homes; smoke detectors
An investigation was conducted to evaluate the significance of smoke detector locations to response time for a specific set of fire conditions in a mobile home. Parameters having the potential of affecting response time include: the physical location within a mobile home such as inside wall vs outside wall or wall vs ceiling installations; the impact of air circulation resulting from the operation of the heating, ventilating, and air-conditioning system; and the basic detector parameter of smoke detector alarm threshold. For the study only photoelectric-type smoke detectors were used. These detectors utilize the Tyndall Effect in their sensing mechanism. This limitation was imposed to limit the number of variables. Detector response was evaluated for the fires in both smoldering and flaming modes. The results of the study provide a case for wall installations as opposed to ceiling installations. Further, inside wall installations may be marginally superior to outside wall installations. The most significant finding of the study suggests that, when in operation, the forced-air circulating system has a major delaying effect on detector response time to a given fire size.

Ghosh, B. K.

Ghosh, B. K.
Protecting the Means of Escape. Detectors in Corridors Not Sufficient.
Fire Research Station, Borehamwood, England
Fire Surveyor, Vol. 16, No. 6, 5-8, December 1987.
escape; residential buildings; fire detectors

Halliwell, R. E.

Halliwell, R. E.; Sultan, M. A.
Guide to the Most Effective Locations for Smoke Detectors in Residential Buildings.
National Research Council of Canada, Ottawa, Ontario
Building Practice Note 62; 11 p. June 1986.
smoke detectors; residential buildings

Halliwell, R. E.; Sultan, M. A.
Method to Determine the Optimum Location for Fire Alarms in Residential Buildings.
National Research Council of Canada, Ottawa, Ontario
Canadian Acoustics, Vol. 17, No. 2, 9-18, 1989.
IRC Paper 1592; NRCC 30417
fire alarm systems; residential buildings; smoke detectors; attenuation

Heskestad, G.

Heskestad, G.; Delichatsios, M. A.
Environments of Fire Detectors. Phase 1. Effect of Fire Size, Ceiling Height and Material. Volume 1. Measurements.
Technical Report.
Factory Mutual Research Corp., Norwood, MA
NBS-GCR-77-86; FMRC Serial 22427; RC76-T-37; 206 p. May 1977.

Available from National Technical Information Services PB-272882

ceiling height; ceilings; cotton; detector location; detectors; fire detectors; polyurethanes; polyvinyl chloride; room fires; rooms; smoldering; wood

An experimental program has been initiated to map ceiling environments to which fire detectors are exposed for various combinations of room geometry, ceiling configuration, fire type, and detector spacing. This report covers Phase I of the program, which considered 1) flat, extensive ceiling areas, 2) a quiescent test space, 3) flaming and smoldering fires of wood, cotton, foamed polyurethane, and polyvinyl chloride, 4) ceiling heights of 8, 15 and 29 ft, and 5) instrument stations at 10, 20, and 40 ft from the geometric fire axis. Measured environmental parameters included temperature, velocity, and optical density. In addition, response times of a set of five fire detectors (heat detectors of fixed temperature, rate-of-rise, and rate anticipation types; one ionization smoke detector; and one photoelectric smoke detector of the reflection type) were recorded at each instrument station. A total of 49 fire tests were conducted. The reduced data are presented in two tables, one listing detector reponse times and the other listing the environmental data. Analysis of the data is presented in a second volume (Volume II) and includes determination of spacing requirements for fire detectors in flaming fires.

Heskestad, G.; Delichatsios, M. A.
Environments of Fire Detectors. Phase 1. Effect of Fire Size, Ceiling Height and Materials. Volume 2. Analysis.
Factory Mutual Research Corp., Norwood, MA
NBS-GCR-77-95; FMRC Serial 22427; 129 p. July 1977.
Available from National Technical Information Services PB-272883

ceiling height; ceilings; cotton; detector location; fire detectors; fire growth; heat detectorts; polyurethanes; polyvinyl chloride; smoke detectors; smoldering fires; temperature rise; wood

This volume is an analysis of experimental data presented in Volume 1 on the ceiling environment and response to this environment by various types of fire detectors. Data and the analysis pertain to flat, extensive ceilings and quiescent surroundings. The results for smoldering fires are found to be of limited utility because of dominant influence of uncontrolled variables such as pre-existing temperature stratifications; however, an anomalous smoke pattern has been explained, which should aid future investigations. The results of environmental variables versus time for the unsteady, flaming fires are found to correlate very well in coordinates which intrinsically account for variations in fire-growth rate and ceiling height. Hence, ceiling temperatures and velocities can be predicted as function of time for any combination of fire-growth rate and ceiling height. Optical densities for a given combustible material are found to be in approximately constant ratio to the local temperature rise. In flaming fires smoke detectors are found to respond at approximately constant temperature rise of the fire gases; this temperature rise depends on the combustible material and mode of fire spread. The response of heat detectors is shown to be predictable theoretically from the temperature and velocity fields and key detector characteristics. The final section of the report deals with spacing requirements of fire detectors in flaming fires as influenced by ceiling height, fire-growth rate, and detector characteristics. The results are presented in graphical and tabular forms.

Heskestad, G.; Delichatsios, M. A.
Environments of Fire Detectors. Phase 2. Effect of Ceiling Configuration. Volume 2. Analysis. Final Report.
Factory Mutual Research Corp., Norwood, MA
NBS-GCR-78-129; 112 p. June 1978.
Available from National Technical Information Services PB-284042

beams; ceiling height; detectors; fire detectors; fire growth; heat detectors; room fires; smoke detectors; spacing; velocity

This volume contains an analysis of experimental data presented in Volume I on (1) the ceiling environment generated by flaming fires under extensive beamed ceilings and (2) the response to this environment by various types of fire detectors. Data on gas temperatures, gas velocities and optical densities have been presented in readily usable form for each of six beam configurations. These data have been converted to "reduced" forms which allow predictions to be made of the environmental variables for any combination of ceiling height and fire growth rate. The experimental response of fire detectors was generally found to conform with available response theories. With the aid of these theories and the data on the "reduced" variables, optimum spacing configurations of fire detectors have been determined as a function of ceiling height for each beam configuration. It is cautioned that the resulting spacing configurations pertain to large, unobstructed beamed ceilings and may be overly conservative in many practical situations.

Heskestad, G.; Delichatsios, M. A.
Evironments of Fire Detectors. Phase 2. Effect of Ceiling Configuration. Volume 1. Measurements.
Factory Mutual Research Corp., Norwood, MA
NBS-GCR-78-128; 172 p. June 1978.
Available from National Technical Information Services PB-290951

beams; ceiling height; detectors; fire detectors; fire growth; heat detectors; room fires; smoke detectors; spacing; velocity

This report describes Phase II of a sustained research program to map ceiling environments to which fire detectors are exposed. Phase I, reported previously, concerned flat, horizontal ceiling of large extent. Phase II extends ceiling measurements of temperature, velocity and optical density to six different beam configurations in extensive, horizontal ceilings. As in Phase I, the response times of variously located sets of fire detectors were

measured (three types of heat detectors, an ionization detector and a photoelectric smoke detector). A total of 21 fire tests were conducted. The reduced data are presented in two tables, one listing detector response times and the other listing environmental data. Analysis of the data is presented in a second volume (Volume II).

Hotta, H.

Hotta, H.
Fire Detection in the Air-Conditioned Room With a Plenum Return Chamber.
Japanese Association of Fire Science and Engineering. Fire Research Annual Conference. May 17-18, 1990, 69-72 pp, 1990.
In: Japanese (Abstract in English)
fire research; fire detection; air conditioning
In tests conducted, it was found that with air conditioning off, fire detection was possible with even a small quantity of smoke. However, when the air conditioning fan is operating, smoke is exhausted through the plenum return chamber. Therefore it is necessary to lessen the space between detectors in order to detect fire by an equal quantity of smoke.

Kennedy, R. H.

Kennedy, R. H.; Riley, K. W. P.; Rogers, S. P.
Study of the Operation and Effectiveness of Fire Detectors Installed in the Bedrooms and Corridors of Residential Institutions.
Fire Research Station, Borehamwood, England
CIB W14/79/03 (UK); CP 26/78; 15 p. April 1978.
fire detectors; residential buildings; operations research; effectivenes; bedrooms; corridors; fire tests

Kraemer, U.

Kraemer, U.
Computerized Procedure for Planning Placement of Fire Detectors. [Ein computergestutztes Verfahren zur Planung fur den Einbau von Flammenmeldern.]
NT Universitat Duisburg, Germany
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '89", 9th. September 26-28, 1989, Duisburg, West Germany, Luck, H., Ed., 775-785 pp, 1989.
In: German
fire detection; fire detectors; planning

Manfredonia, S.

Manfredonia, S.
Fire Detectors: What Kind, Where?
W. A. DiGiacomo Associates, New York
Consulting Engineer, Vol. 49, No. 10, 90-91, October 1977.
fire detectors; heat detectors; flame detectors; photoelectric detectors; ionization detectors

Matthews, J. D.

Matthews, J. D.; Walker, F. K.
Assessment of the Effects of Ceiling-Mounted Destratification Fans on the Performance of "Products of Combustion" Type Fire Detectors. Final Report. April-September 1983.
Naval Civil Eng. Lab., Port Hueneme, CA
ESL-TR-8366; 36 p. January 1984.
Available from National Technical Information Services AD/A-140182
fire detectors; fire detection; combustion products; warning systems; ventilation; ceilings; response time; fire prevention; safety; combustion products
The introduction of ceiling mounted destratification fans into rooms protected by "products of combustion" type fire detectors will reduce the effectiveness of these detectors. This report documents the tests, test results and recommendations concerning the effects of ceiling mounted destratification fans on "products of combustion" type fire detectors arising from the experiments and data analysis performed at the Naval Civil Engineering Laboratory under sponsorship of the U.S. Air Force Engineering and Services Center.

Mniszewski, K.

Mniszewski, K.; Waterman, T. E.
Effectiveness of Duct-Installed Smoke Detectors in Two Different Ventilation System Configurations. Final Report.
IIT Research Inst., Chicago, IL
GSA/PBAC-78-127; IIT Project J6464; 113 p. February 26, 1979.
smoke detectors; ventilation; smoke control; ducts

National Electrical Manufacturers Association

National Electrical Manufacturers Association
Guide for Proper Use of Smoke Detectors in Duct Applications. 1987-1988 Edition.
National Electrical Manufacturers Assoc., Washington, DC, 28 p. 1988.
smoke detectors; ducts
The Guide is updated every 5 years.

Newman, J. S.

Newman, J. S.
Fire Tests in Ventilated Rooms--Detection of Cable Tray and Exposure Fires. Interim Report.
Factory Mutual Research Corp., Norwood, MA
EPRI NP-2751; 93 p. February 1983.
Available from National Technical Information Services DE83-901860

fire tests; ventilation; cable trays; exposure; electrical insulation; smoke detectors; electrical cables

Okubo, I.

Okubo, I.
Follow-Up Survey on Actually-Installed Fire Detectors.
Japan Fire Equipment Inspection Corp.
U. S./Japan Government Cooperative Program on Natural Resources. Panel on Fire Research and Safety. Volume 6.
Fire Detection. October 19-22, 1976, Tokyo, Japan, 1-8 pp, 1976.
fire detection; fire research; fire safety; fire detectors; humidity; mechanical properties; corrosion; test methods

Oliverson, R. L.

Oliverson, R. L.
M/E Update: Smoke Detectors.
Senior Editor, Specifying Engineer
Specifying Engineer, Vol. 39, No. 2, 119-123, February 1978.
smoke detectors; fire losses; ionization detectors; spacing

Pasek, F.

Pasek, F.
Location of Smoke Detector Important for Operation.
Rixson-Firemark, Inc.
Fire Engineering, Vol. 130, No. 6, 22, June 1977.
smoke detectors; installation

Stroup, D. W.

Stroup, D. W.; Evans, D. D.
Use of Computer Fire Models for Analyzing Thermal Detector Spacing.
National Bureau of Standards, Gaithersburg, MD
Fire Safety Journal, Vol. 14, 33-45, 1988.
fire detection; computers; fire models; heat detection; fire detection systems
This paper presents a methodology for evaluating heat detection systems installed in buildings. Previous work for use primarily in designing new thermal fire detection systems was used as a starting point. The previous work was enhanced and supplemented to make it more useful for evaluating existing systems. The resulting equations were programmed into a user-interactive computer program.

Stroup, D. W.; Evans, D. D.; Martin, P. M.
Evaluating Thermal Fire Detection Systems (English Units). Final Report.
National Bureau of Standards, Gaithersburg, MD
NBS SP 712; 557 p. April 1986.
Available from National Technical Information Services PB86-206570
fire alarm systems; fire detection; fire detection systems; fire hazard assessment; fire protection; fire suppression; heat detectors; sprinkler systems
This report presents a methodology for evaluating heat detection systems installed in buildings. Previous work for use primarily in designing new thermal fire detection systems was used as a starting point. The previous work was enhanced and supplemented to make it more useful for evaluating existing systems. The resulting equations were programmed into a user interactive computer program. This program is availble in both BASIC and FORTRAN and will run on mainframes as well as personal computers. In addition, a modified version of the FORTRAN program was used to develop an extensive set of tables listing detector acivation times for given building geometries, detector characteristics, and fire growth rates. These tables are useful for quick evaluation of alternative heat detector installations. Finally, practical examples are included to illustrate the use of the tables and computer programs.

Stroup, D. W.; Evans, D. D.; Martin, P. M.
Evaluating Thermal Fire Detection Systems (SI Units). Final Report.
National Bureau of Standards, Gaithersburg, MD
NBS SP 713; 557 p. April 1986.
Available from Government Printing Office, Washington, DC 003-003-02741-3
fire alarm systems; fire detection; fire detection systems; fire hazard assessment; fire protection; fire suppression; heat detectors; sprinkler systems
This report presents a methodology for evaluating heat detection systems installed in buildings. Previous work for use primarily in designing new thermal fire detection systems was used as a starting point. The previous work was enhanced and supplemented to make it more useful for evaluating existing systems. The resulting equations were programmed into a user interactive computer program. This program is available in both BASIC and FORTRAN and will run on mainframes as well as personal computers. In addition, a modified version of the FORTRAN program was used to develop an extensive set of tables listing detector activation times for given building geometries, detector characteristics, and fire growth rates. These tables are useful for quick evaluation of alternative heat detector installations. Finally, practical examples are included to illustrate the use of the tables and computer programs.

Thorne, P. F.

Thorne, P. F.; Melinek, S. J.; Theobald, C. R.
Thermal Performance of Sprinkler Heads.
Fire Research Station, Borehamwood, England
Fire Safety Journal, Vol. 14, No. 1&2, 89-99, July 1, 1988.
Society of Fire Protection Engineers. Fire Detection and Suppression...Today's Technology.

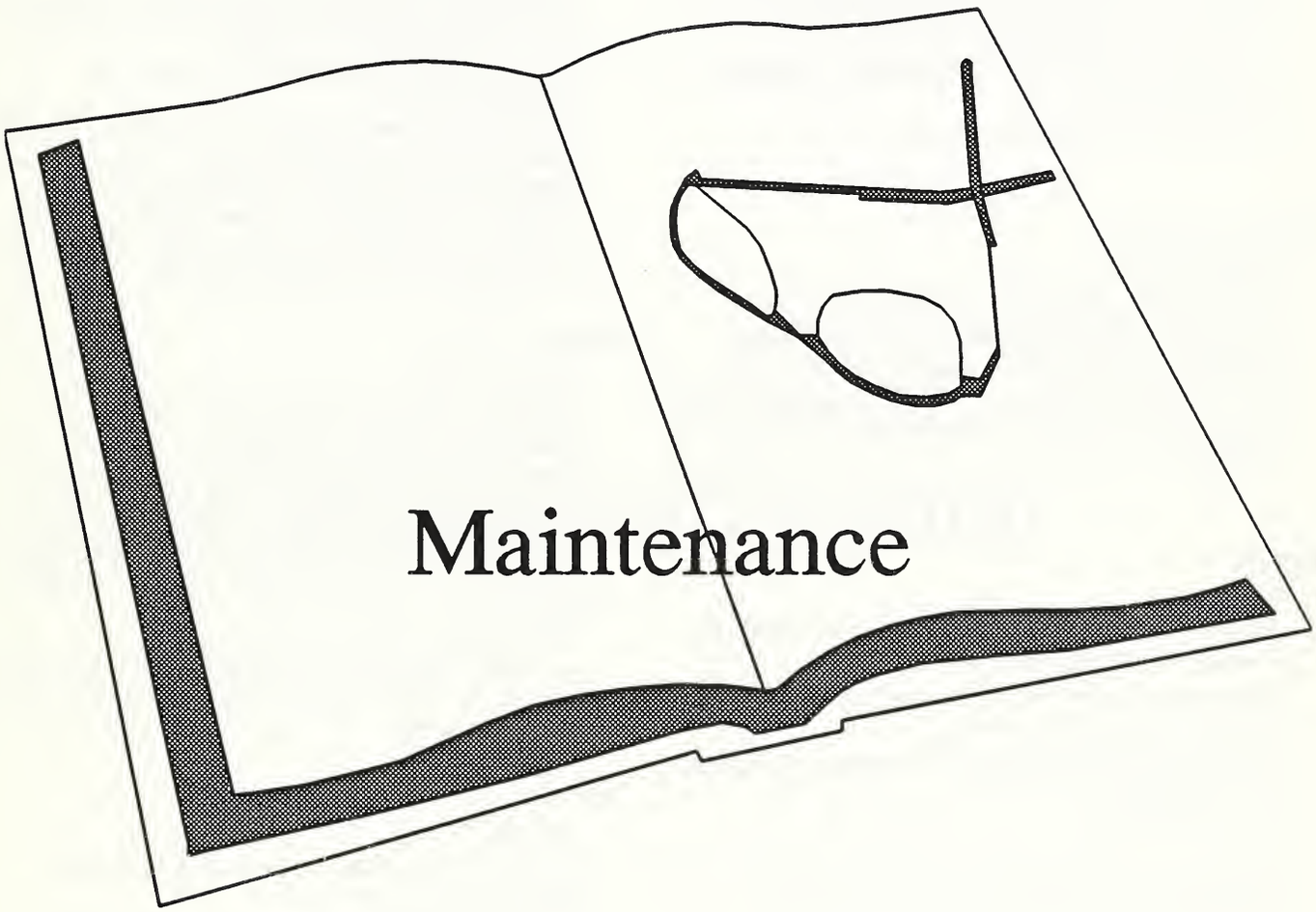
March 9-11, 1987, Linthicum Heights, MD, 1-26 pp, 1988.
sprinklers; heat transmission; gas temperature; time constant; heat transfer
A methodology for describing, measuring and prescribing the performance of sprinkler heads when subject to heating regimes is necessary for three purposes: 1. Quality control during manufacture, 2. 'Approval' by interested bodies for particular applications, 3. Development of a 'model' for activation time of sprinklers that can be incorporated into computer codes for fire scenarios, involving both life and property safety.

Vannerberg, C.

Vannerberg, C.
Numerical Simulation of Smoke Detectors Using Field Models.
(Numerisk Simulering av Detektion-Miljo Med Faltmodeller.)
Lund Univ., Sweden
LTUVDG/(TVBB 3052); 47 p. 1988.
In: Swedish (Abstract in English)
smoke detectors; response time; temperature; smoke density

Waterman, T. E.

Waterman, T. E.; Harpe, S. W.; Christian, W. J.
Engineering Approach to the Positioning of Fire Detectors in Residences.
IIT Research Institute, Chicago, IL
Underwriters Labs., Inc., Northbrook, IL
SFPE TR 77-06; 35 p. 1977.
Society of Fire Protection Engineers (SFPE).
SFPE Seminar:
Engineering an End to Residential Life Loss.
May 17, 1977,
SFPE TR 77-06, Washington, DC, 1977.
residential buildings; fire detectors; fire tests; smoke detectors; installation; sensitivity



Maintenance

While this section has few papers, most are of interest and contain useful information on the relation between maintenance and operational reliability [e.g., Kamath *et al* 1990, Moore 1987, and Nielsen 1986].

Bean, M. J.

Bean, M. J.
Installation Use and Maintenance of Automatic Fire Detection Equipment.
Honeywell Ltd., England
Fire Service Technical College. Automatic Fire Detection in Non-Domestic Residential Premises. Technical Study. Paper 3. April 3-5, 1978, Gloucestershire, England, 13-21 pp, 1978.
fire detection; installing; maintenance

Hall, J. R., Jr.

Hall, J. R., Jr.
Most Recent Statistics on Smoke Detector Installation and Maintenance in U. S. Homes.
National Fire Protection Assoc., Quincy, MA
Fire Prevention, No. 215, 30-32, December 1988.
smoke detectors; installation; maintenance; fire statistics; home fires

Hygge, S.

Hygge, S.
Smoke Detectors in Apartments and One-Family Houses: A Comparison Between the Maintenance, Care and Performance of Free and Purchased Smoke Detectors.
National Swedish Institute for Building Research, Gavle, Sweden
Fire Safety Journal, Vol. 15, No. 3, 195-210, 1989.
smoke detectors; apartments; housing; maintenance; performance evaluation; insurance

Jernigan, W.

Jernigan, W.
Keeping the Smoke Detectors Operational: The Dallas Experience.
Dallas Fire Dept., TX
Fire Journal, Vol. 81, No. 4, 57,59-60+, July/August 1987.
smoke detectors

Kamath, A. R. R.

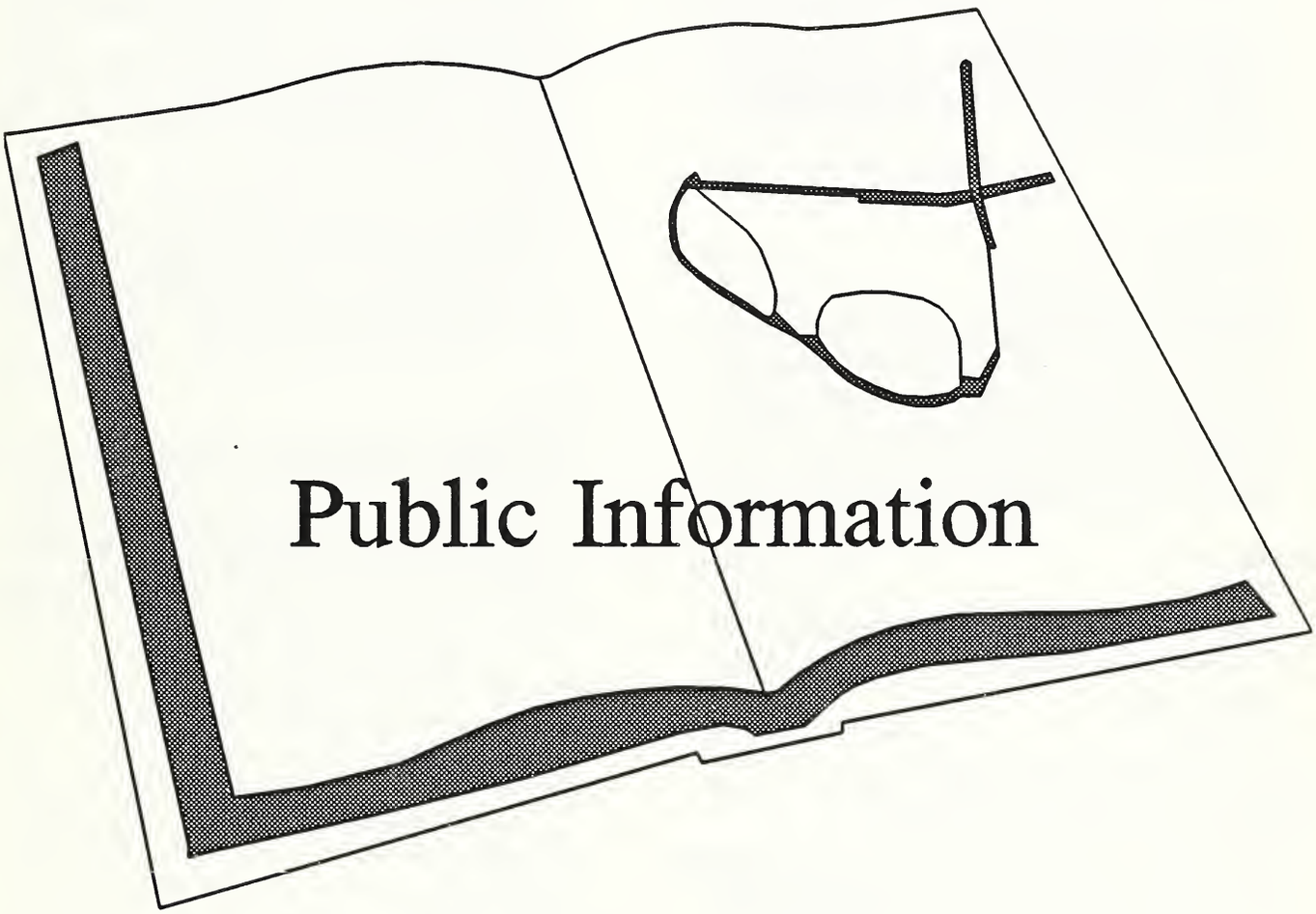
Kamath, A. R. R.; Keller, A. Z.; Selman, A. C.
Fire Alarm Maintenance in Health Service Industries.
Bradford Univ., UK
Department of Health and Social Security, London, England
Advances in Reliability Technology Symposium, 7th. 1982, 2C/2-14 pp, 1982.
hospitals; statistical analysis; fire alarm systems; maintenance; tests
Data collected from 55 hospitals in the north of England is analysed using nonparametric statistics. Factors such as false alarms, time spent on testing/maintenance are identified and investigated. Various statisitcal models are employed to examine the fire alarm incident rates and annual false alarm rate predictions made.

Moore, W. D.

Moore, W. D.
Testing and Maintenance--Increasing Fire Detection Systems Reliability.
Mass Fire Alarms of New England, Lowell, MA
Society of Fire Protection Engineers. Fire Detection and Suppression...Today's Technology. March 9-11, 1987, Linthicum Heights, MD, 1-5 pp, 1987.
fire detection systems; tests; maintenance
In recent major fires, fire detection systems either failed to operate, failed to operate correctly, or the public failed to respond properly.

Nielsen, E.

Nielsen, E.
Inspection and Maintenance of Active and Passive Fire Protection.
Danish Fire Protection Assoc., Copenhagen, Denmark
Saudi Arabian Standards Organization. Protection of Buildings From Fires. Symposium. February 8-10, 1982, Riyadh, Saudi Arabia, 129-135 pp, 1982.
fire safety
Fire safety in building depend on the fire protection measures built in at the design of the building. Fire safety depends on the maintenance of the fire protection, both passive (fire doors, etc.) and active measures (fire detection systems, sprinklers, etc.)



Public Information

The papers in this section are written for general audiences and contain little technical information. Papers deal with the promotion of detector installation in residences and other occupancies, and with special topics such as the hearing impaired [DeVoss 1990, Nober 1990, and Tucker 1985] and radiation safety from ion chambers [Wernli 1990]. The current British view is covered in two papers by the same author [Ashmore 1988].

Ashmore, F. S.

Ashmore, F. S.
Assessment of the Risk.
Fire Safety Consultants
University of Edinburgh. Recent Developments in Fire Detection and Suppression Systems. (With Additional Papers From a Course of the Same Title--July 8-9, 1987). November 10-12, 1986, Edinburgh, Scotland, 8 pp, 1987.
fire risks; fire protection; risk assessment

Ashmore, F. S.
Selection of the System.
Fire Safety Consultants
University of Edinburgh. Recent Developments in Fire Detection and Suppression Systems. (With Additional Papers From a Course of the Same Title--July 8-9, 1987). November 10-12, 1986, Edinburgh, Scotland, 13 pp, 1987.
fire detection; fire suppression; risk assessment

Bemis, B.

Bemis, B.
What's "Bugging" Your Smoke Detectors?
American Fire Journal, Vol. 39, No. 1, 17,29, January 1987.
smoke detectors

Benjamin/Clarke Associates, Inc.

Benjamin/Clarke Associates, Inc.
Fire Deaths - Causes and Strategies for Control.
Benjamin/Clarke Assoc., Inc., Kensington, MD 78 p. 1984.
fire safety; smoke detectors; fire protection; public awareness; death; sprinklers

Cassidy, V. M.

Cassidy, V. M.
M/E Update Security Systems.
Specifying Engineer, Vol. 45, No. 5, 103-107, May 1981.
fire detection systems; life safety

Cerberus

Cerberus
Age of the Data Rush.
Alarm--Modern Fire Protection and Security Systems Review, No. 104, 1-5, August 1988.
computers; fire alarm systems; fire tests; fire detection; warning systems
There is hardly anything so coveted today than are data: everyone is clinging to them as if they were pure gold. By analogy we could rightly speak of an age of data rush. As the gold rush was in old times, so the way to, and the handling of data today is accompained by risks and dangers, and anyone inpossession of them is well advised to take good care of them! Here too, there are thieves and forgers, people who offer "light" coin, and others who lull themselves into a sense of false security. Data are in demand, and are, therefore, in danger.

Cohn, J.

Cohn, J.
NBS Center Studies Ways to Improve Fire Safety.
Journal of the West Virginia State Firemen's Assoc., Vol. 3, No. 1, 4-7, Dec-Jan 1984.
fire safety; fire research; fire suppression; smoke detectors; health care facilities; fire models

Consumer Product Safety Commission

Consumer Product Safety Commission
What You Should Know About Smoke Detectors.
Consumer Product Safety Comm., Wash., DC 5 p. January 1985.
smoke detectors

Consumer Reports

Consumer Reports
Are Smoke Detectors Hazardous?
Consumer Reports, Vol. 42, No. 1, 52-54, January 1977.
smoke detectors; health hazards; fire fighters

Consumer Reports
Smoke Detectors.
Consumer Reports, Vol. 49, No. 10, 564-567, October 1984.
smoke detectors

Consumer Reports
Update: Smoke Detectors.
Consumer Reports, Vol. 42, No. 5, 283, May 1977.
smoke detectors

Consumers Digest

Consumers Digest
How to Survive a Fire.
Consumers Digest, 30-34, July/August 1981.
survival; smoke detectors

Crevling, F.

Crevling, F.
Public Relations Idea.
Park Forest Fire Dept., IL
Fire Chief, Vol. 20, No. 4, 52, April 1976.
smoke detectors; public awareness

DeVoss, F.

DeVoss, F.
Bringing Alarms to Light--Signaling for the Hearing Impaired.
Underwriters Labs., Inc., Northbrook, IL
UL Lab Data, Vol. 20, No. 1, 4-7, 1990.
lighting equipment; fire alarm systems; signals

Federal Emergency Management Agency

Federal Emergency Management Agency
Ounce of Prevention.
Federal Emergency Management Agency, Washington, DC
FA-76; 17 p. May 1988.
fire prevention; sprinklers; smoke detectors

Fire

Fire
How a Swedish Home Smoke Detector Campaign is Meeting With Success.
Fire, Vol. 77, No. 952, 37-38, October 1984.
fire safety; smoke detectors
Not a day seems to go by without the radio or TV news reader telling us of a fire--usually overnight--which has cost the lives of one or more member of a family. And newspapers have a succession of stories with headlines like "Family perish; Mother trapped with four children". What can we do to reduce the toll of these residential fires? Must we accept the deaths as an inevitable price to be paid for the privilege of living with gas, electric, coal and paraffin fires, of smoking cigarettes or playing with matches, or being careless with cleaning fluids? What we must accept is the "an Englishman's home is still his castle", but at the same time we must besiege him with fire safety missives. The Fire Protection Association, through the Central Fire Lisison Panel Network and with the support of the government, is about to do this by making "Fire costs lives" the theme of this year's Fire Safty Week, from October 22-27. Fire joins the campaign with this special feature hich includes reports of efforts made to solve the problem of home fire safety in Scandinavia and throughout Europe.

Fire Fighting in Canada

Fire Fighting in Canada
Fire Detection Through Thermal, Smoke and Product of Combustion Detectors.
Fire Fighting in Canada, Vol. 20, No. 6, 8,20, December/January 1977.
fire detection; heat detectors; flame detectors

Fleming, R. P.

Fleming, R. P.
Applications/Limitations of QRS Technology.
Sprinkler Quarterly, 15-27, Spring 1987 and Fire Safety Journal, Vol. 14, Nos. 1&2, 75-88, July 1, 1988,
sprinklers; quick response sprinklers

Garbacz, C.

Garbacz, C.
Smoke Detector Effectiveness and the Value of Saving a Life.
Missouri Univ., Rolla
Economics Letters, Vol. 31, No. 3, 281-286, 1989.
smoke detectors; effectiveness; life safety

Gatfield, A. J.

Gatfield, A. J.
Visit to the United States of America and Canada and a Brief Study of the Fire Safety Scene.
34 p. April 1982.
fire safety; fire codes; enforcement; escape means; fire fighters; handicapped; smoke detectors; sprinklers; arson

Gilbert, K.

Gilbert, K.
FIREBUSTER: Baltimore City Fire Department Mounts Detector Offensive.
Baltimore Evening Sun Newspaper
Firehouse, Vol. 7, No. 5, 30-32, May 1982.
fire detectors; smoke detectors

Glass, R. A.

Glass, R. A.; Rubin, A. I.
Fire Safety for High-Rise Buildings: The Role of Communications.
National Bureau of Standards, Gaithersburg, MD
NBS BSS 115; 47 p. April 1979.

Available from National Technical Information Services AD/B-053232
decision analysis; fire detection systems; smoke detection; smoke movement; smoke control; extinguishment; fire safety; high rise buildings; people movement; systems engineering

Grant, C. C.
Grant, C. C.; Mulhaupt, R.
Current Research Activity of the National Fire Protection Research Foundation. Short Communication.
National Fire Protection Assoc., Quincy, MA
Fire Safety Journal, Vol. 15, No. 6, 477-483, 1989.
research facilities; halons; sprinklers; fire detection; self contained breathing apparatus; risk assessment; flammable liquids; refrigerants

Green, L.
Green, L.
Smoke and Heat Detectors.
Specifying Engineer Editor, Des Plaines, IL
Specifying Engineer, Vol. 52, No. 1, 117-120, July 1984.
smoke detectors; heat detectors

Hirst, R.
Hirst, R.
Underdown's Practical Fire Precautions. 3rd Edition, Gower Publishing Co. Ltd., England, 1989.
fire protection

Holland, K.
Holland, K.
Fire Detection--Towards Greater Public Safety.
Fire Prevention, No. 211, 29-32, July/Aug. 1988.
fire detection; fire safety; standards; public awareness

Jaffer, R. P.
Jaffer, R. P.
Meeting Today's Fire Problems...Fire Detection/Alarm Systems.
Consulting Engineer, Tampa, FL
Specifying Engineer, Vol. 45, No. 5, 82-87, May 1981.
fire alarm systems; fire detection; life safety

Jameson, F.
Jameson, F.
Notification and Alarm Systems--The Las Vegas Story.
Las Vegas Fire Dept., Las Vegas, NV
AIA Research Foundation. Life Safety and the Handicapped, 1980 Conference. Final Report. October 26-30, 1980,
Washington, DC, NBS-GCR-82-283, Kennett, E. W., Editor, 36-38 pp, 1982.
Available from National Technical Information Services PB82-194515
fire alarm systems
Can the deaf hear smoke detectors? Do ambulatory patients find it easy to get away from fire, especially in highrise buildings? Can the blind keep their sense of direction in a fire? Can mentally retarded people be taught fire safety? Under the direction of Chief Sam Cooper, the Las Vegas Fire Department has found "yes" to some of those questions, and has implemented the resulting knowledge and technology.

Jurgen, R. K.
Jurgen, R. K.
Where There's Smoke...There'd Better be a Smoke Detector.
Inexpensive, Life-Saving Systems Vie for Consumer Interest.
IEEE Spectrum, V. 13, No. 8, 24-26, Aug. 1976.
smoke detectors; life safety; detector location

Maclean, J.
Maclean, J.
Early Warning Saves Lives.
Fire Fighting in Canada, Vol. 20, No. 2, 39-40,58, April/May 1976.
warning systems; smoke detectors; ionization detectors; insurance

Markman, H. M.
Markman, H. M.; Crombie, P. E., Jr.
Smoke Detectors and Legislation: An Update on State and Local Laws.
Federal Emergency Management Agency, Washington, DC
31 p. June 1979.
Available from Government Printing Office
smoke detectors; legislation

McGehan, F. P.
McGehan, F. P.
Clearing the Air on Smoke Detectors.
National Bureau of Standards, Gaithersburg, MD
National Bureau of Standards Dimensions, Vol. 61, No. 3, 7-9, March 1977.
smoke detectors

McGehan, F. P.
Life-Saving Investments: Smoke Detectors for the Home.
National Bureau of Standards, Gaithersburg, MD
National Bureau of Standards Dimensions, Vol. 60, No. 4, 6-8, April 1976 and Fire, Vol. 69, No. 855, 184-185,September 1976.,
smoke detectors
These two stories illustrate dramatically what countless Americans have been discovering--that the purchase of a relatively inexpensive detector may save their homes--and lives--in the event of a fire. Smoke detector sales reached 50,000 when they came on the market in 1971.

Mniszewski, K. R.

Mniszewski, K. R.; Waterman, T. E.; Harpe, S.
Detector Directory.
IIT Research Inst., Chicago, IL
Underwriters Labs., Northbrook, IL
176 p. December 1978.
fire detectors; manufacturing; bibliographies

National Fire Protection Association

National Fire Protection Association
Smoke Detectors--A Sound You Can Live With!
National Fire Protection Assoc., Quincy, MA
BR-28; 6 p. 1988.
smoke detectors; fire safety

National Fire Protection Association
Smoke Detectors--Fire Safety While You Sleep.
National Fire Protection Assoc., Quincy, MA
BR-4; 6 p. 1988.
smoke detectors; fire safety; sleep; escape means

National Fire Protection Association
What is America's Fire Problem?
National Fire Protection Assoc., Quincy, MA
5 p. 1990.
costs; statistics; fire risks; fire prevention; fire detection; fire safety

Nober, H.

Nober, H.
Alarms for the Hearing-Impaired.
Fire Prevention, No. 233, 28-31, October 1990.
fire alarm systems; handicapped; warining systems; smoke detectors; evacuation; color; noise (sound); signals; light scattering detectors

Peissard, W. G.

Peissard, W. G.
Automatic Fire Alarms--Are They a Benefit or Nuisance?
Cerberus AG, Mannedorf, Switzerland
Fire, Vol. 75, No. 925, 62, July 1982.
fire alarm systems; fire detection systems

Pendergrast, R. F.

Pendergrast, R. F.
Selling the Public on Smoke Detectors.
Northfield Rescue Squad., IL
Fire Chief Magazine, Vol. 25, No. 12, 37-38, December 1981.
smoke detectors; public awareness

Perkins, C.

Perkins, C.; Berenblut, B. J.
Does Electronic Equipment Need Automatic Fire Detection?
Insurance Technical Bureau, England
Fire, Vol. 73, No. 900, 24, June 1980.
electrical equipment; fire detection; fire protection

Public Technology, Inc.

Public Technology, Inc.
Impact of the Use of Smoke Detectors. Urban Consortium for Technology Initiatives.
Information Bulletin.
Public Technology, Inc., Washington, DC
PTI-78/504; 27 p. 1978.
smoke detectors; technology utilization

Specifying Engineer

Specifying Engineer
Systems Challenge: Balanced Life-Safety Design With Sprinklers and Detection/Alarm Devices.
Specifying Engineer, Vol. 54, No. 5, 82-86, 88-89, October 1985.
fire protection; sprinkler systems

Sylvia, D.

Sylvia, D.
U. S. Programs Eye Grass Roots, Tipton and McCormack Tell FDIC.
Associate Editor
Fire Engineering, Vol. 129, No. 5, 36-38,40,42, May 1976.
research facilities; smoke detectors; training; fire fighters; education; consumer protection

Taylor, K. T.

Taylor, K. T.
Burning Down the School...The Lessons We Don't Learn Can Hurt Us.
National Fire Protection Assoc., Quincy, MA
Fire Journal, Vol. 84, No. 3, 60-64,66,68-69, May/June 1990.

schools; fire statistics; fire detection systems; fire suppression

Tucker, T.

Tucker, T.
Sound Idea Helps Hearing Imparied.
Fort Wayne Fire Dept., IN
Fire Chief, 39-40, June 1985.
handicapped; smoke detectors

U. S. Conference of Mayors

U. S. Conference of Mayors
U. S. Conference of Mayors. Final Report. Fire Prevention Poject 1980 to the U. S. Fire Administration. March 1981.
Conference of Mayors, Washington, DC
75 p. March 1981.
Available from National Technical Information Services PB81-205130
fire prevention; fire safety; education; fire protection; fire alarm systems; smoke detectors; fire detection systems; regulations; building codes; arson
This is the final report of a one year fire prevention project with mayors of 73 cities and the U. S. Fire Administration. The primary purpose of the project was to assess the needs and priorities of mayors in the area of fire protection. This report includes an overview of the year's activities with final products appended to the approprate sections. It includes: Fire Prevention and Arson Resolutions, Mayors Leadership Institute report and evaluation, Mayors Manual on Fire Prevention (includes the manual), and an Assessment of Fire Prevetnion Needs and Strategies with report on the assessment. This final report also includes nine recommendations from the Mayors Conference to the U. S. Fire Administration. The recommendations include, the need for a basic cost/benefit analysis for retrofitting older buildings for sprinkler and smoke detector systems, and studies that address the reassignment of fire personnel for activities such as master planning and public education and incorporating more comprehensive fire data systems in cities.

U. S. Consumer Product Safety Commission

U. S. Consumer Product Safety Commission
What You Should Know About Smoke Detectors.
Consumer Product Safety Commission, Washington, DC, 11 p. 1978.
smoke detectors; public awareness

U. S. Department of Commerce

U. S. Department of Commerce
Reducing the Nation's Fire Losses--The Research Plan.
Department of Commerce, Washington, DC
64 p. January 1976.
fire losses; research facilities; fire research; ignition; fire spread; fire growth; fire detection; fire suppression; escape means; refuge; fire protection

U. S. Department of Commerce
Smoke Detectors--What They Are and How They Work.
Department of Commerce, Washington, DC
LC 1074; 8 p. December 1976.
smoke detectors

U. S. Department of Commerce
Wake Up! Smoke Detectors...Can Save Your Life.
Department of Commerce, Washington, DC
8 p. December 1976.
smoke detectors

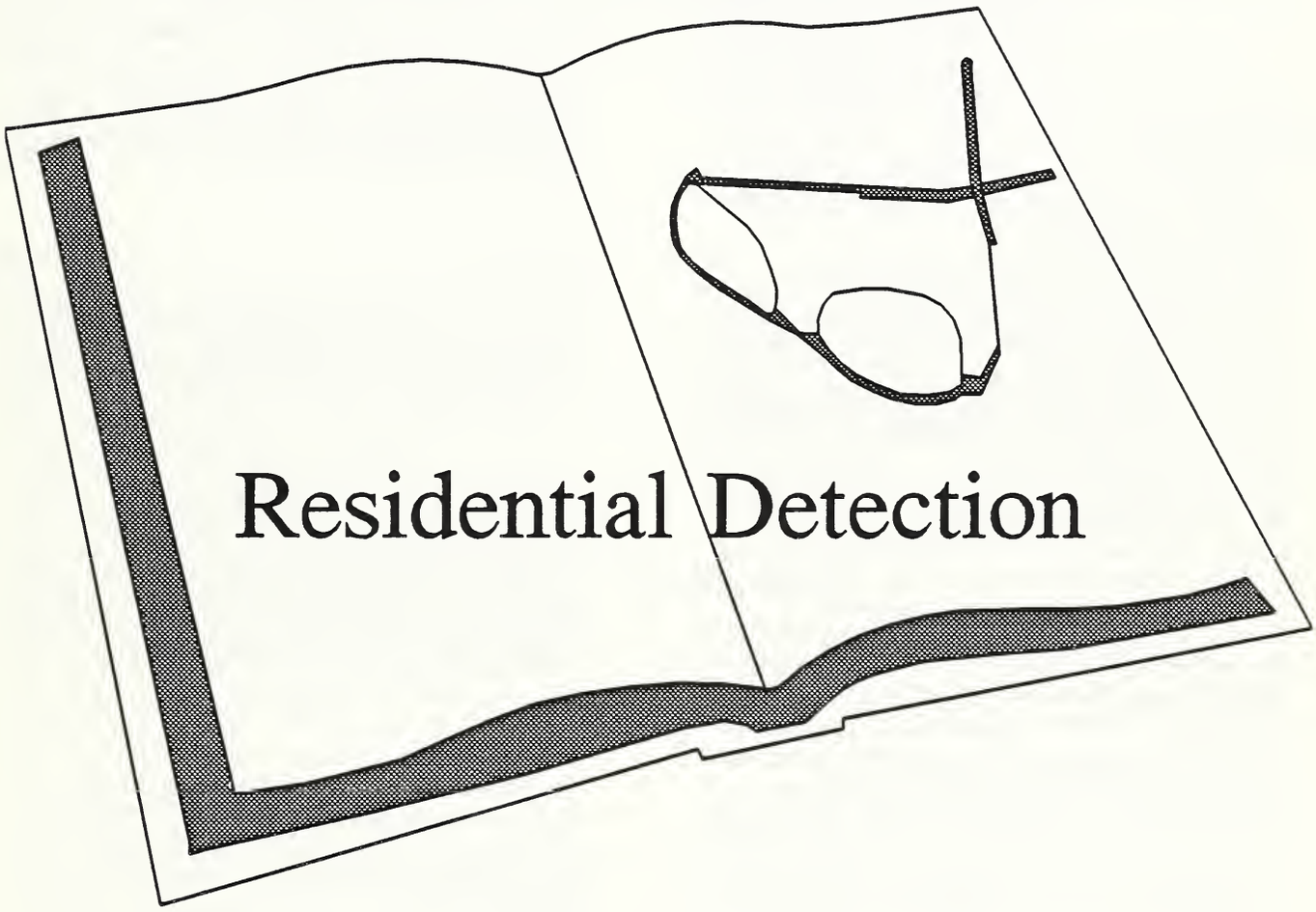
U. S. Department of Commerce; National Fire Prevention and Control Administration
Annual Report of the Secretary of Commerce on Implementation of the Federal Fire Prevention Control Act of 1974.
Department of Commerce, Washington, DC
National Fire Prevention and Control Admin., Washington, DC
Annual Report; 48 p. July 1978.
research facilities; fire research

Walsh, H.

Walsh, H.
National Mandate for Smoke Detectors.
Federal Emergency Management Agency, Washington, DC
International Fire Chief, Vol. 52, No. 8, 8-9, August 1986.
smoke detectors

Wernli, C.

Wernli, C.
Radiological Risk From Am-241 in Ionization Smoke Chambers.
Eidgenoessisches Institute fuer Reaktorforschung, Wuerenlingen, Switzerland
EIR-369; 42 p. June 1979.
Available from National Technical Information Services DE82-700830
smoke detectors; aerosols; ionization chambers; radiation hazards; radiation protection; risk assessment; inhalation
The author discusses the risk to man from the use of ionization smoke chamber detectors with an Am-241 radiation source. The estimated dose is compared with that due to natural radioactivity.



Residential Detection

This is the second largest section behind Detector Performance. Of note among the more than 100 papers in this section are the final reports of several studies begun in the 70's; the Toledo Study [Moyer *et al* 1990] which looked at detector performance and owner attitudes, and a study of Automatic Residential Remote Alarm Systems (AARAS) [Baileys 1990] which began in a planned community in Texas. Also, there is a compilation of HUD data from mobile homes [NFDC 1990] and an examination by the IAFC Foundation of detectors installed in homes [Gratz *et al* 1990]. Also interesting are papers on the performance of smoke detectors in college dorms [Breen 1990] and in hotels in the US [Bill 1990] (describing full-scale tests) and in Japan [Takemoto 1990] (addressing false alarm statistics).

A number of papers on audibility/acoustics [Myles 1979, 1990, Nober 1978, 1981, 1983, Haliwell 1986, and Fidell 1990] should be of benefit in general audibility research. There are also a number of retrospective articles on the long term effectiveness of mandatory detector laws [Mass 1990, Jansky 1976, LeCoque *et al* 1990, Brannigan 1977, Smith 1977, Ozment 1977, Halpin *et al* 1978, etc.].

Baileys, T. P.

Baileys, T. P.
Automatic Residential Remote Alarm System Survey. Final Report.
Fire Administration, Washington, DC
Final Report; 16 p. September 1979.
Available from National Technical Information Services PB80-124811
fire alarm systems; residential buildings; false alarms; fire safety; fire departments; warning systems; surveys; questionnaires; smoke detectors
This is a compilation of the results of a survey conducted by the United States Fire Administration and the International Association of Fire Chiefs Foundations to study the impact of smoke detector use and to obtain the views of fire chiefs with respect to an Automatic Residential Remote Fire Alarm System (ARRAS). Results indicated interest in the remote alarm concept. About 75 percent of the respondents linked increased smoke detector use to a reduction in fire losses in their respective jurisdictions. More than 90 percent felt that notification 15 minutes earlier would be important in reducing fire losses, and agreed with large-scale ARRAS implementation assuming false alarms were maintained at an acceptable level. For 65 percent of the chiefs, five to ten false alarms per thousand homes per year would be acceptable. Nearly half favored use of a telephone call-back or a manual abort-switch to prevent false alarms. A majority thought they could modify their present first alarm response assignment to single family residences when given early notification.

Best, R.

Best, R.
Coates House Hotel Fire: 20 Die, 36 Rescued Down Ladders in 92-Year-Old Kansas City Hotel.
National Fire Protection Assoc., Quincy, MA
Fire Journal, Vol. 72, No. 4, 23-29, July 1982.
hotels; death; high rise buildings; fire protection; damage; fire detection systems

Best, R.
Dwelling Fire Kills Two, Melrose, Massachusetts.
National Fire Protection Assoc., Quincy, MA
Fire Journal, Vol. 71, No. 1, 12-14, Jan. 1977.
residential buildings; death; heat detectors

Best, R.
Three Die in Dwelling Fire; Gift Smoke Detector Not Installed.
National Fire Protection Assoc., Quincy, MA
Fire Journal, Vol. 73, No. 1, 74-76, Jan. 1979.
residential buildings; death; smoke detectors

Best, R.
Three Die in Single-Family Dwelling Fire.
National Fire Protection Assoc., Quincy, MA
Fire Journal, Vol. 71, No. 5, 81-84,109, September 1977.
residential buildings; death; heat detectors; smoke detectors

Bill, R. G., Jr.

Bill, R. G., Jr.
Life Safety Team: Smoke Detectors and Sprinklers in Hotels.
Factory Mutual Research Corp., Norwood, MA
Fire Journal, Vol. 84, No. 3, 28-31,34-35,37, May/June 1990.
hotels; smoke detectors; sprinklers; large scale fire tests; test facilities; beds (furniture); smoldering

Bill, R. G., Jr.
Response of Smoke Detectors to Smoldering-Started Fires in a Hotel Occupancy. Technical Report.
Factory Mutual Research Corp., Norwood, MA
FMRC J.I. 0Q0R4.RA; 72 p. November 1988.
smoke detectors; hotels; smoldering; fire tests; beds (furniture); corridors; ventilation

Bill, R. G., Jr.; Kung, H. C.; Brown, W. R.; Hill, E. E., Jr.
Evaluation of Extended Coverage, Sidewall Sprinklers and Smoke Detectors in a Hotel Occupancy. Technical Report.
Factory Mutual Research, Norwood, MA
Journal of Fire Protection Engineering, Vol. 1, No. 3, 77-98, 1989.
FMRC J.I.0M3N5.RA(4); 87 p. May 1988.
sprinklers; smoke detectors; hotels; fire tests

Bowallius, L.

Bowallius, L.
Residential Fire. (Bostadsbrand.)
National Defence Research Inst., Stockholm, Sweden
FOA Report E10003-1.2; 68 p. June 1988.
In: Swedish (Abstract in English)
residential buildings; fire losses; rescue operations; fire spread; fire statistics; effectiveness
The report is a presentation of a study of about 1000 residential fires and operations of rescue units. The purpose has been to illustrate the correlation between the environment, fire loss and rescue opeations and finally to find a method to make this illustration. A large number of data (observations and estimates) which describe the environment, fire spread, smoke spread, operations and course of events have been analysed. The study inter alia points out that the number of fatalities could have been reduced 40-50 percent if smoke detectors had existed and that the operation units in almost all fires were larger than necessary. One of the most interesting results is the description of the risk for fire spread as a function of time in different kind of dwellings.

Brannigan, V.

Brannigan, V.
Legal Implications of Mandatory Home Fire Detection.
Consumer Product Safety Commission, Washington, DC
Fire Journal, Vol. 71, No. 2, 59-65, March 1977.
fire detectors; residential buildings; smoke detectors; fire protection; legislation

Breen, D. E.

Breen, D. E.
Do Smoke Detection Systems Work in College Dormitories?
Harvard Univ., Cambridge, MA
SFPE TR 84-08; 34 p. May 1984.
dormitories; smoke detectors; false alarms; fire alarm systems; fire behavior; fire protection; fire safety; life safety; human response

Breen, D. E.
Improved Life Safety Through More Reliable Smoke Detection Systems.
Harvard Univ., Cambridge, MA
New Technology to Reduce Fire Losses and Costs. October 2-3, 1986, Luxembourg, Elsevier Applied Science Publishers, NY, Grayson, S. J. and Smith, D. A., Editors, 227-234 pp, 1986.
smoke detectors; life safety; false alarms

Breen, D. E.
Toward More Reliable Residential Smoke Detection Systems.
Harvard Univ., Cambridge, MA
Journal of Fire Protection Engineering, Vol. 2, No. 1, 1-10, 1990.
smoke detectors; false alarms; fire statistics

Bright, R. G.

Bright, R. G.
Advances in Residential Smoke Detection.
National Bureau of Standards, Gaithersburg, MD
Fire Journal, Vol. 68, No. 6, 69-77, Nov. 1974.
National Fire Protection Association. Fire Protection Structure and Systems Design. Open Learning Fire Service Program. 315-324 pp, 1982.
smoke detectors; smoke detection; residential buildings; fire statistics

Bright, R. G.
Domestic Fire Detectors--Technical Developments.
National Bureau of Standards, Gaithersburg, MD
Fire Surveyor, Vol. 7, No. 4, 33-38, Aug. 1978.
fire detectors; smoke detectors; ionization detectors
Four years ago, the annual production rate for smoke detectors in the U.S. was around a half-million units per year. By the end of 1977, as far as we have been able to determine, the annual rate of production has reached some 10 million units per year. It is estimated that by the

end of 1977 somewhere around 30 million of these detectors had been installed in single-family homes, apartments and mobile homes in the U. S.

Bright, R. G.
Status Report on Residential Smoke Detectors.
National Bureau of Standards, Gaithersburg, MD
Fire Marshals of North America Meeting. In Conjunction with the 81st Annual Meeting of the National Fire Protection Association. May 16-19, 1977, Washington, DC, 1-17 pp, 1977.
smoke detectors; fire alarm systems
The purpose of this presentation is to give you a status report on residential smoke detectors. This report will be presented in a "good news, bad news" format.

Bright, R. G.
Technical Developments of Domestic Fire Detectors.
National Bureau of Standards, Gaithersburg, MD
International Fire, Security and Safety Exhibition and Conference. April 24-28, 1978, London, England, 9-16 pp, 1978.
fire detectors; smoke detectors; ionization detectors
In 1974, I appeared before this Conference and my subject was the same as it is today, domestic fire detectors. In the four years since that presentation, there have been many changes in domestic fire detectors, particularly in the U.S. In the time available to me today, I'll describe some of the more significant technical developments which have occurred, some of the problems encountered, and some of our visions of the future.

Bryan, J. L.

Bryan, J. L.; Milke, J. A.
Examination and Analysis of the Dynamics of the Human Behavior in the Fire Incident at Chesapeake Hall on February 3, 1980.
Maryland Univ., College Park
NBS-GCR-80-275; 43 p. June 30, 1980.
Available from National Technical Information Services PB80-218373
smoke; fire alarm systems; fire departments; fire investigations
This fire incident occurred on the second floor, north wing of Chesapeake Hall, University of Maryland at Baltimore County in Catonsville, Maryland. The fire incident was simultaneously detected by the resident assistant on the second floor by smoke in her room, the activation of a smoke detector in resident room 257, and the activation of a trouble alarm in the resident director's apartment on the first floor at approximately 0359. The resident assistant opened her room door and observed heavy smoke and flames in the corridor on the north wing adjacent to room door 257. She returned to her room, 266 and dialed the public safety dispatcher on 3133 to have him notify the Baltimore County Fire Department in accordance with the facility emergency procedures. The resident director on the first floor, investigating the trouble alarm heard screams from the second floor and investigated and upon seeing smoke activated the local alarm system at the station on the first floor. The Baltimore County Fire Department received the alarm at 0403.

Budnick, E. K.

Budnick, E. K.
Estimating Effectiveness of State-Of-The-Art Detectors and Automatic Sprinklers on Life Safety in Residential Occupancies.
National Bureau of Standards, Gaithersburg, MD
Fire Techology, Vol. 20, No. 3, 5-22, Aug. 1984.
NBSIR 84-2819; 81 p. January 30, 1984.
Available from National Technical Information Services PB84-153980
fire losses; life safety; residential buildings; sprinklers systems; smoke detectors
The report provides a qualitative assessment of the life safety impact of early warning fire detection and automatic sprinkler technology in residential occupancies. This assessment is based on the results of full scale studies and statistics on residential fire fatalities from the NFIRS data base. Estimates of the impact of three alternatives, smoke detectors, standard automatic sprinklers, and residential sprinklers, are provided for major fire hazard scenarios in residential occupancies. The results of this study indicate that significant life safety benefits can be derived from broad application of detectors and sprinklers in all residential buildings. Further work is necessary to reduce the gaps which exist in our understanding of the performance limits, cost-effectiveness, and reliability of these devices. In addition, there are residential scenarios, for example, occupants intimately exposed to a fire, where the impact of these devices appears marginal. A quantitative approach is outlined that can lead to a more accurate assessment of the impact of detectors and sprinklers. An initial framework is presented which identifies the key parameters for residential like safety. A mathematical expression is proposed as a success criterion. Work is underway to extend the framework to sufficient detail to permit formulation of appropriate analytical expressions necessary for quantitative evaluation of specific parameters and their interralationships.

Bukowski, R. W.

Bukowski, R. W.
Field Investigation of Residential Smoke Detectors. Final Report.
National Bureau of Standards, Gaithersburg, MD
Fire Journal, Vol. 71, No. 2, 18,21-30,41, March 1977.
NBSIR 76-1126; 45 p. November 1976.

Available from National Technical Information Services PB-260878
detector sensitivity; escape; fire tests; heat detectors; building fires; residential buildings; smoke detectors
A test program was undertaken to evaluate the effect of sensitivity and placement of residential smoke detectors on their response to fires in homes. The tests were conducted in two homes scheduled for demolition and used actual furnishings in typical configurations. In addition to the detector response times, the homes were highly instrumented with data on smoke, temperature, and gas concentration measured for all tests. The tests showed that smoke detectors can be highly effective in providing adequate warning of a fire before conditions in the home become dangerous.

Bukowski, R. W.
Fire Detection and Alarm Systems.
National Bureau of Standards, Gaithersburg, MD
NBSIR 86-3360; 14 p. April 1986.
Available from National Technical Information Services
fire detection; fire detection systems; fire alarm systems; smoke; heat detection
Fire detectors sense the presence of fire by responding to changes in their local environment which are indicative of a fire within their associated area of coverage. The goal is to select conditions for sensing which appear as early as possible and which are present at levels sufficiently above those which might be produced by non-fire conditions to minimize false alarms. Such conditions are referred to as fire signatures. Not all unwanted fire conditions produce all fire signatures, so optimum detector system design requires that the detector types selected must be matched to the hazard present.

Bukowski, R. W.
Report for UJNR Panel Detection in USA 1980-1982.
National Bureau of Standards, Gaithersburg, MD
U.S./Japan Government Cooperative Program on Natural Resources. Fire Research and Safety. 6th Joint Panel Meeting of the UJNR Proceedings. May 10-14, 1982., Tokyo/Tsukuba, Japan, Building Research Inst., Tokyo, Japan, 10-14 pp, 1983.
detection; smoke detectors
In summary, this period has been one of limited technological growth and little new research. All indications are that the residential detectors currently being produced and installed are functioning admirably and will have an increasing impact on the reduction of fire losses as their use becomes more universal.

Callan, J. J.

Callan, J. J.
Motel Disaster Averted.
Fairfax City Fire and Rescue Service, VA
Fire Chief Magazine, Vol. 28, No. 1, 46-47, January 1984.
hotels; smoke detectors; fire departments

Carpenter, D. J., Jr.

Carpenter, D. J., Jr.; Jennings, C.
Power Off to Hard-Wired Detector in Nine-Fatality House Fire, Peoria, Illinois (April 11, 1989). With Supplement on Role of Smoke Detectors in Fatal Townhouse Fire, Annapolis, Maryland. USFA Fire Investigation Technial Report Series.
TriData Corp., Arlington, VA
Report 031; 31 p. 1989.
fire investigations; home fires; death; wooden structures; smoke detectors; arson; apartments

Cerberus

Cerberus
Recent Tests on Fire Safety in Hotels.
Alarme--Modern Fire Protection and Security Systems Review, No. 105, 4-6, November 1988.
hotels; fire safety; fire tests; fire endurance tests
Hotels and guesthouses vary widely, both in structure and in outfitting and interior decoration. The safety of guests and personnel depends in any event on suitable provisions being made, which a) as far as possible, prevent fires from even occurring, b) offer no chance of spreading to a fire which has nevertheless occurred, c) ensure rapid detection of the fire and raising the alarm, d) facilities effective intervention by automatic equipment or hotel personnel until the fire department arrives.

Cote, A. E.

Cote, A. E.
Field Test and Evaluation of Residential Sprinkler Systems. Part 3.
National Fire Protection Assoc., Quincy, MA
Fire Technology, Vol. 20, No. 2, 41-46, May 1984.
sprinklers; mobile homes; smoke detectors; fire tests

Custer, R. L. P.

Custer, R. L. P.
Fire Power: Making the Movie.
Worcester Polytechnic Inst., MA
Fire Journal, Vol. 80, No. 6, 23-26,31-33,64, November 1986.

home fires; fire spread; fire growth; upholstered furniture; flame spread; smoke detector; ignition; temperature; smoke; sprinklers; carbon monoxide; flashover

Demers, D. P.

Demers, D. P.
Improperly Placed Smoke Detector Fails to Save Two Children.
National Fire Protection Assoc., Quincy, MA
Fire Journal, Vol. 72, No. 3, 43-44, May 1978.
smoke detectors; children; death; multifamily housing; wood; apartments

Doerschuk, D. C.

Doerschuk, D. C.; Kleszczelski, S. E.
Investigation of Improved Sensor/Actuator Concepts for Residential Sprinkler Systems. Final Report. June 1979-December 1979.
Battelle Columbus Labs., Columbus, OH
FA-9; G-8293; 71 p. May 1980.
fire detectors; fire protection; sprinklers; residential buildings; sensitivity

Eguchi, Y.

Eguchi, Y.
Automatic Fire Detection in Japanese Dwellings.
Association of Fire Alarms of Japan
U. S./Japan Government Cooperative Program on Natural Resources. Panel on Fire Research and Safety. Volume 6.
Fire Detection. October 19-22, 1976, Tokyo, Japan, 1-15 pp, 1976.
fire detection; fire research; fire safety; residential buildings; fire detectors; false alarms; heat detectors; smoke detectors; installation;tests

Federal Emergency Management Agency

Federal Emergency Management Agency
Evaluation of Residential Smoke Detectors Under Actual Field Conditions. Final Report.
Federal Emergency Management Agency, Washington, DC
FA-60; 71 p. Marcy 1982.
smoke detectors; residential buildings

Federal Emergency Management Agency
Smoke Detectors: Don't Stay Home Without One.
Federal Emergency Management Agency, Washington, DC
L-163; 6 p. October 1988.
smoke detectors; safety

Fidell, S.

Fidell, S.
Evaluation of Effectiveness of Residential Fire Detection System Audible Warning Signals.
Bolt Beranek and Newman, Inc., Canoga Park, CA
National Fire Protection Association. Annual Meeting, 83rd.
May 1979, St. Louis, MO, 1-9 pp, 1979.
warning systems; fire detection systems; evaluation; effectiveness; residential buildings; noise (sound); smoke detectors; sleep

Fire

Fire
Lead Given on Automatic Fire Detection for Householders.
Fire, Vol. 78, No. 946, 581-582,614, April 1984.
fire detection

Fire Engineering

Fire Engineering
Edmonton Loses Detector Battle But Continues War to Save Lives.
Fire Engineering, Vol. 129, No. 11, 122-123, November 1976.
smoke detectors; fire protection; building codes; legislation

Fire Engineering
Sprinklers, Detectors Protect High-Rise.
Fire Engineering, Vol. 129, No. 9, 44-45, September 1976.
high rise buildings; sprinklers; fire detectors

Fire Journal

Fire Journal
Fire Damage Drastically Reduced Due to Florida "Detection" Program.
Fire Journal, Vol. 72, No. 6, 85,91, November 1978.
smoke detectors; fire detectors; public awareness; fire safety

Fire Prevention

Fire Prevention
Self-Contained Smoke Detectors.
Fire Prevention, Vol. 174, 21-23, Nov. 1984.
smoke detectors

This code of practice has been compiled by EURALARM (Association of European Manufacturers of Fire and Intruder Alarm Systems) in conjunction with BFPSA (The British Fire Protection Systems Association Ltd) to provide guidance for prospective users of self-contained smoke detectors on the application and limitations of these devices for the detection of fire in domestic dwellings.

Fire Surveyor

Fire Surveyor
Self-Contained Detectors. BFPSA's View.
Fire Surveyor, Vol. 11, No. 1, 30, February 1982.
smoke detectors; installing

Fire Surveyor Journal

Fire Surveyor Journal
Specification for Automatic Fire Alarm Systems for Domestic Dwellings. Part 2. Self-Contained, Multi-Sensitive Fire Detectors Providing Staged Audible and Other Alarm Signals.
Fire Surveyor Journal, Vol. 9, No. 2, 38-39, April 1980.
fire alarm systems; residential buildings; fire detectors

First Alert

First Alert; McDonald's
Plan to Get Out Alive. VHS Tape. 45 Minutes. 1988.
home fires; time; escape means; smoke; smoke detectors

Fuller, S. K.

Fuller, S. K.
Risk Exposure and Risk Attitude of Homeowners in Fire Protection Investment Decisions.
National Institute of Standards and Technology, Gaithersburg, MD
NISTIR 89-4212; 82 p. December 1989.
Available from National Technical Information Services PB90-141383
fire protection; risk analysis; sprinkler systems; decision making; risks
The report demonstrates that the Analytic Hierarchy Process (AHP) is a promising decision tool for evaluating fire protection systems for homeowners. It lays the ground for development of specialized computer software for applying the AHP to decisions of individual homeowners. Unlike conventional methods of economic analysis, the AHP integrates quantifiable and qualitative variables. The study explores how to include in the decision-making process information on an individual's risk exposure and risk attitude, information which is generally difficult or impossible to quantify. By differentiating between risk exposure and risk attitude, this application goes beyond the AHP's conventional treatment of risk. The AHP is applied to the choice of purchasing smoke detectors, a sprinkler system, or a combination of the two.

Gallagher, E. L.

Gallagher, E. L.
Is NBS Wrong?
A-T-O Inc.
Fire Journal, Vol. 71, No. 6, 86-89, Nov. 1977.
research facilities; smoke detectors; standards; life safety; sleep; bedrooms

Gancarski, J. L.

Gancarski, J. L.; Timoney, T.
Home Smoke Detector Effectiveness.
National Fire Protection Assoc., Quincy, MA
Fire Technology, Vol. 20, No. 4, 57-62, November 1984.
smoke detectors
In August 1983, the National Fire Protection Association was awarded a cooperative agreement with the Federal Emergency Management Agency/United States Fire Administration to study issues relative to home smoke detector installation, maintenance, and reliability, and to review smoke detector application programs in selected communities.

Gratz, D. B.

Gratz, D. B.; Hawkins, R. E.
Evaluation of Residential Smoke Detector Performance Under Actual Field Conditions. Final Report. Phase 1.
International Association of Fire Chiefs Foundation, Washington, DC
FEMA/FA-15; 50 p. June 1980.
Available from National Technical Information Services PB80-209604
smoke detectors; residential buildings; fire alarm systems; fire protection; evaluation
This report presents the first major effort to evaluate the effectiveness of residential smoke detectors under actual field conditions. Objectives of the study were to examine how smoke detectors perform when an unwanted fire occurs and to develop a data base to provide direction for future research in the performance of smoke detectors. The report supports previous research studies which indicate that smoke detectors in residential properties are preventing injuries, saving lives and reducing fire losses. The data was furnished by twelve jurisdictions, reporting on 1168 fire incidents that were responded to by fire departments. There were 1589 smoke detectors in the incidents reported. It was found that detectors provided

the early warning to life threatening situations in more than 40% of the unwanted fires. A smoke detector alarm reduced the potential for serious injury or death in 27% of the unwanted fires; fire loss was reduced in 35% of the unwanted fires.

Gratz, D. B.; Hawkins, R. E.
Evaluation of Smoke Detectors in Homes. Interim Report. Phase 1.
International Association of Fire Chiefs Foundation, Washington, DC
FA-26; 38 p. September 1980.
smoke detectors; residential buildings; legislation

Halliwell, R. E.

Halliwell, R. E.; Sultan, M.A.
Attenuation of Smoke Detector Alarm Signals in Residential Buildings.
National Research Council of Canada, Ottawa, Ontario
NRCC 25897; IRC Paper 1372 AND
International Association for Fire Safety Science. Fire Safety Science. Proceedings. 1st International Symposium.
October 7-11, 1985, Gaithersburg, MD, Hemisphere Publishing Corp., NY, Grant, C. E. and Pagni, P. J., Editors, 689-697 pp, 1986.
smoke detectors; residential buildings

Halpin, B. M.

Halpin, B. M.; Dinan, J. J.; Deters, O. J.
Assessment of the Potential Impact of Fire Protection Systems on Actual Fire Incidents.
Fire Problems Program.
Johns Hopkins Univ., Laurel, MD
FPP TR 35; 78 p. October 1977.
fire protection; case histories; casualties; residential building; smoke detectors; fire alarm systems; fire suppression

Harpe, S. W.

Harpe, S. W.; Waterman, T. E.; Christian, W. J.
Detector Sensitivity and Siting Requirements for Dwelling--Phase 2. Final Report.
IIT Research Inst., Chicago, IL 60616
NBS-GCR-77-82; 379 p. February 1977.
Available from National Technical Information Services PB-263882
detector sensitivity; escape; fire tests; gas detectors; heat detectors; residential fires; smoke detectors
The contract for a field investigation of the effectiveness of residential smoke detectors was extended to cover 36 additional tests investigating details not completely covered in the first report. The objective of the second phase summer/fall conditions without air conditioning and to expand available information on high volume, two story structures. The effects of open windows, new technical developments in photoelectric detector design, and the response of semiconductor type residential gas detectors and mechanically powered heat detectors were also included. The tests reinforced the conclusions of the first phase of testing. They showed that open windows have little appreciable affect of life safety and detection times, and that semiconductor gas sensing fire detectors exhibit fuel specific response characteristics which seriously degraded the effectiveness in certain types of fires.

Harwood, B.

Harwood, B.
Residential Smoke Detectors--A Consumer Product Safety Commission Evaluation.
Consumer Product Safety Commission, Washington, DC
International Fire Chief, Vol. 46, No. 11, 20-23, November 1980.
smoke detectors; evaluation

Home Office

Home Office
Automatic Fire Detection in Non-Domestic Residential Premises.
Home Office, London, England
FIR/78-82/72/1; 7 p. October 13, 1978.
fire detection; fire detectors; residential buildings

Hygge, S.

Hygge, S.
Installation and Reliability of a Free Smoke Detector.
National Swedish Institute for Building Research, Gavle, Sweden
International Association for Fire Safety Science. Fire Safety Science. Proceedings. 1st International Symposium.
October 7-11, 1985, Gaithersburg, MD, Hemisphere Publishing Corp., NY, Grant, C. E. and Pagni, P. J., Editors, 739-748 pp, 1986.
smoke detectors

Hygge, S.
Smoke Detectors in Apartments and One-Family Houses: Fire Risk, Property Loss and the Presence of Smoke Detectors.
National Swedish Institute for Building Research, Gavle, Sweden

Fire Safety Journal, Vol. 15, No. 6, 421-435, 1989.
smoke detectors; apartments; housing; fire risk; insurance

Hyun, M. K.

Hyun, M. K.
United States of America Before Federal Trade Commission In the Matter of Figgie International, Inc., a Corporation.
Initial Decision.
Administrative Law Judge
Docket 9166; 77 p. October 23, 1984.
heat detectors; fire alarm systems

International Fire Chief

International Fire Chief
Residential Smoke Alarm Report.
International Fire Chief, Vol. 46, No. 9, 62-67, September 1980.
fire alarm systems; residential buildings; fire detectors

Isner, M. S.

Isner, M. S.
Successful Residential Sprinkler Activation. Cobb County, Georgia, May 2, 1985. 1 Child, 3 Adults Saved. Summary Investigation Report.
Federal Emergency Management Agency, Washington, DC
National Bureau of Standards, Gaithersburg, MD
Fire Command, Vol. 53, No. 1, 22-27, Jan. 1986.
NFPA-GA-CO-1; 24 p. 1985.
fire extinguishment; plastics; smoke detectors; sprinkler systems; residential buildings
Since their first installation in 1982, Cobb County sprinkler systems have successfully controlled a number of fires in residential properties. In each case the fires did not cause injuries and fire officials reported property damage was minimal. The most dramatic of these incidents occurred on May 2, 1985 when a fire started in a toddler's bedroom. During the incident, a circuit breaker tripped cutting power to the apartment's only smoke detector, and the sleeping occupants did not receive early warning. Still, a residential sprinkler extinguished the fire, alerted occupants, and allowed safe evacuation of the building. The result of this incident differs sharply from the results of many other similar residential fires in which tragic losses of life have occurred. One such incident happened in Hollywood, Florida on the night of December 20, 1982. The lack of early occupant warning and extinguishment of the fire in its incipient phase resulted in the death of a child. A comparative analysis of the Cobb County and Hollywood incidents demonstrates the life safety benefits of residential sprinklers. It also suggests that residential sprinklers will be able to maintain a tenable environment for occupants in residential fire scenarios that, in the past, has resulted in tragic losses of life.

Isner, M. S.; Smith, R.
Fire in Boarding Home: A Success Story. NFPA Investigation Report.
National Fire Protection Assoc., Quincy, MA
Fire Marshals Assoc. of North America
Fire Journal, Vol. 80, No. 2, 75-77, 79-81, March 1986.
board and care homes
Unlike other boarding home fires investigated by the NFPA, smoke detectors and an automatic sprinkler system operated in this one, preventing serious injuries and deaths. The fire is significant because it demonstrates the importance that an automatic sprinkler system can have in improving the level of protection in boarding homes--occupancies with an identified fire problem.

Jansky, D.

Jansky, D.
Detector Law Can Affect Old Homes.
Farmers Branch Fire Dept., TX
Fire Engineering, Vol. 129, No. 5, 31, May 1976.
smoke detectors; installations

Jansky, D.
Ultimate Answer--Strong Codes.
Farmers Branch Fire Dept., TX
Fire Chief, Vol. 20, No. 4, 54-55, April 1976.
smoke detectors; residential buildings; building codes

Johnson, P. F.

Johnson, P. F.; Brown, S. K.
Smoke Detection of Smoldering Fires in a Typical Melbourne Dwelling.
Scientific Services Branch, Port Melbourne, Australia
Commonwealth Scientific and Industrial Research Organization, Highett, Australia
Fire Technology, Vol. 22, No. 4, 295-340, November 1986.
smoke detectors; residential buildings; smoldering; visibility; escape

Johnson, P.

Johnson, P.; Moulen, A. W.
Fire Detection in a Typical Cottage. Report of Tests Conducted at Springwood, NSW.
Central Investigation and Research Lab., Chatswood, New South Wales

Experimental Building Station, Chatswood, New South Wales
Technical Record 453; 32 p. November 1979.
fire detection; residential buildings; fire tests

King, E.

King, E.
Smoke Detectors--Why Every Home Should Have Them.
Greendale Fire Dept., WI
Fire Chief, Vol. 20, No. 4, 49-51, April 1976.
smoke detectors; residential buildings; life safety

Klem, T. J.

Klem, T. J.
New York Dwelling Fire Kills Family of Seven. Investigation Report.
National Fire Protection Assoc., Quincy, MA
Fire Journal, Vol. 78, No. 6, 42-45, 51, November 1984.
home fires; kerosene
Careless use of a portable kerosine heater, lack of early detection, stored combustible liquids and other combustible materials combined to snuff out the lives of an entire family--in a fire that might have been prevented. The NFPA investigated this fire in order to document and analyze significant factors that resulted in the loss of life.

Kyte, G.

Kyte, G.
Rooming House Fire Claims Five Lives. Fire Investigation Report.
National Fire Protection Assoc., Quincy, MA
Fire Command, Vol. 53, No. 12, 18-21, December 1986.
home fires; fire deaths; arson; ignition source; fire detection systems; combustion; interior finishes

Lathrop, J. K.

Lathrop, J. K.
Dormitory Fire Leaves One Dead Twenty-Three Hospitalized, Saratoga Springs, New York.
National Fire Protection Assoc., Quincy, MA
Fire Journal, Vol. 70, No. 6, 5-7,13, November 1976.
dormitories; death; trash; students; heat detectors

LeCoque, P. G.

LeCoque, P. G.; Harris, K.
State by State...An Update of Residential Smoke Detector Legislation.
BRK Electronics, Aurora, IL
Pittway Corp., Northbrook, IL
Fire Journal, Vol. 84, No. 1, 40-45,47, January/February 1990.
smoke detectors; legislation; residential buildings; fire statistics

Maguire, H. M.

Maguire, H. M.
Seattle Stresses Home Smoke Detectors in Neighborhood Meetings After a Fire.
Seattle Fire Dept., WA
Fire Engineering, Vol. 129, No. 12, 27-28, December 1976.
smoke detectors; residential buildings; fire prevention; fire fighters

Massachusetts Public Interest Research Group

Massachusetts Public Interest Research Group
To Save a Life: Smoke Detectors and the Law in Massachusetts.
Massachusetts Public Interest Research Group, Boston
NSF/OSS-82007; 47 p. December 1982.
Available from National Technical Information Services PB83-173781
smoke detectors; safety devices; fire protection; warning systems; legislation; regulations; fire safety; fire detection systems; fire departments
The effectiveness of Massachusetts' laws regarding the installation of smoke detectors is examined. The report is based on the results of a survey of 500 renter households as well as the results of interviews with officials from fire departments throughout the state. It was found that many tenants are without adequate legal protection and that there is uneven enforcement of the laws that have been enacted. Uniform support for comprehensive statewide regulations and/or legislation was found. It is recommended that regulations mandate the installation of smoke alarms. In addition, because almost half of the landlords of rental units in Massachusetts have failed to install smoke alarms, it is suggested that voluntary compliance by landlords is not sufficient to protect the lives of the tenants.

Massey, J. D.

Massey, J. D.; Jones, V.
Detector in Every Other Home: Results of a Survey of Smoke and Fire Detector Owners. Full Report.
Elrick and Lavidge Inc., Atlanta, GA
FA-54; 150 p. November 1980.
Available from National Technical Information Services PB81-218091
smoke detectors; fire detectors; housing

Masten, H. L.

Masten, H. L.
Detectors Give Princeton High Degree of Protection.
Princeton Univ., NJ
Fire Engineering, Vol. 133, No. 5, 18, May 1980.
smoke detectors; dormitories; fire alarm systems

Masten, H. L.
Fire Protection at Princeton: Ten Years of Successful Operation.
Princeton Univ., NJ
Fire Journal, Vol. 74, No. 3, 128-130, May 1980.
fire protection; dormitories; smoke detectors

McGehan, F. P.

McGehan, F. P.
Inexpensive Detector Suggested to Save Lives, Property in Home.
National Bureau of Standards, Gaithersburg, MD
Fire Engineering, Vol. 129, No. 8, 60,62, Aug. 1976.
fire alarm systems; fire detectors; fire protection; heat detectors; smoke detectors

McGuire, J. H.

McGuire, J. H.
Fire Detectors for the Home.
National Research Council of Canada, Ottawa, Ontario
Building Practice Note 9; 7 p. September 1978.
fire detectors; installation

McLoughlin, E.

McLoughlin, E.
Smoke Detector Legislation: Its Effect on Owner-Occupied Homes.
Johns Hopkins Univ., Baltimore, MD
American Journal of Public Health, Vol. 75, No. 8, 858-862, August 1985.
Thesis; 217 p. April 1984.
smoke detectors; legislation

Miles, T.

Miles, T.
Fire Detection System in Georgian Mansion Two Weeks Too Late.
Fire, Vol. 77, No. 956, 15,20, February 1985.
fire detection systems; fire investigations

Moore, D. A.

Moore, D. A.
Remote Detection and Alarm for Residences: The Woodlands System.
Fire Admin., Washington, DC
Fire Journal, Vol. 74, No. 1, 57-61, Jan. 1980.
fire detection; fire alarm systems; residential buildings; smoke detectors; fire statistics

Morbidity and Mortality Weekly Report

Morbidity and Mortality Weekly Report
Prevalence of Smoke Detectors in Private Residences--Dekalb County, Georgia, 1985.
Morbidity and Mortality Weekly Report, Vol. 35, No. 28, 445-448, July 18, 1986.
smoke detectors; surveys

Moyer, N.

Moyer, N.; Miller, S. E.
Pilot Study Design to Test Effectiveness of Smoke Detection Devices in Private Dwellings. Final Report.
Toledo, OH
HUD/RES-1214; 198 p. August 14, 1977.
Available from National Technical Information Services PB-275944
smoke detectors; residential buildings; fire safety; fire alarm systems; fire protection; warning systems; performance evaluation; fire prevention
This is the final report of a pilot research project conducted in Toledo, Ohio, sponsored by the National Fire Prevention and Control Administration under Grant No. 7X002 which was designed to investigate factors related to fire hazard awareness and fire prevention measures of families in private dwellings. More specifically, the major focus of the study dealt with the effectiveness of smoke detectors plus the attitude, beliefs, and behavior patterns associated with their use.

Myles, M. M.

Myles, M. M.
Analysis of Acoustic Signals Produced by Residential Fire Alarms.
Bolt Beranek and Newman, Inc., Cambridge, MA
National Fire Protection Association. Annual Meeting, 83rd.
May 1979, St. Louis, MO, 1-17 pp, 1979.
fire alarm systems; acoustic sensors; warning systems; residential buildings; fire detectors; UL 217; standards

Myles, M. M.; Fidell, S. A.
Evaluation of the Detectability of Residential Fire Alarms.
Bolt Beranek and Newman, Inc., Cambridge, MA
Report 3833; 38 p. November 1978.
fire alarm systems; residential buildings; fire detectors; acoustic sensors; signals; attenuation

National Fire Data Center

National Fire Data Center
Fire Performance Evaluation of the Federal Mobile Home Construction and Safety Standard.
National Fire Data Center, Washington, DC
249 p. 1980.
Available from National Technical Information Services PB81-193104
mobile homes; construction; safety standards; residential buildings; trailers; fire safety; performance evaluation; fire protection; fireresistant materials; construction materials; fire damage; smoke detectors; fire investigations
This report was developed for the Division of Mobile Home Standards, HUD, by the National Fire Data Center. The results of the study show that it is estimated that between 12,000 and 20,000 mobile home fires occur each year, causing 400-450 deaths, 1000-1600 injuries and $70-120 million in direct property loss. This study analyzed over 400 in-depth fire investigations to assess the role of smoke detectors, exit facilities, fire stopping, and flame resistance provided by wall, ceiling, and other interior construction materials in fire origin and development, and fire losses. Results of the Data Center show that the HUD standard has been effective in reducing deaths, injuries, and property loss in mobile home fires. Further reductions are expected to continue until all homes built before the date of the Standard have been replaced in about the year 2000. One important finding underscores the value of smoke detectors. Mobile homes with smoke detectors as required by the Standard, had much lower rates of deaths, injuries, and property loss than mobile homes without detectors.

National Technical Assistance

National Technical Assistance
Implementing a Community-Wide Automatic Residential Remote Alarm System: The Westland Plan.
National Technical Assistance, Wayne, MI
FA-52; 56 p. February 1981.
smoke detectors

Nober, E. H.

Nober, E. H.; Peirce, H.; Well, A.
Waking Effectiveness of Household Smoke and Fire Detection Devices. Final Report.
Massachusetts Univ., Amherst
NBS-GCR-83-439; 92 p. July 1983.
Available from National Technical Information Services PB83-256511
adults; alarm responses; auditory perception; decibal levels; developmentally disabled; children; elderly persons; fire departments; noise (sound); sleep; smoke detectors; wakefulness
The present work consists of three experiments. Experiment measured the frequency response and directionality of five typical home smoke alarms. In experiment B, normal-hearing young adults were subjected to alarm signals of 85, 70, and 55 dBA while asleep in their own bedrooms under both low and moderate background noise levels. Times required to awaken, turn off the alarm and phone the fire department ranged from 49-115 seconds at 55 dBA to 24-109 sec at 85 dBA with low background noise. With moderate background noise, times increased to 45-137 sec for the 55 dBA signal and 36-119 sec for the 70 dBA signal. In experiment C, subjects included families with and without children, varying types of housing, elderly, and developmentally disabled populations. Times required to awaken and evacuate all subjects in the household were measured. Mean evacuation times for these groups were 48.5 sec for the families, 65.8 seconds for the elderly, and 57.9 sec. for the developmentally disabled. The report concludes that college-aged subjects can be awakened and alerted with alarm levels as low as 55 dBA (even with moderate background noise) and that evacuation times for families, geriatric and developmentally disabled populations seem to be in a range of one to two minutes.

Nober, E. H.; Peirce, H.; Well, A. D.
Acoustic Spectral Characteristics of Household Smoke Detector Alarms.
Massachusetts Univ., Amherst
Fire Journal, Vol. 75, No. 3, 94-98,144, May 1981.
fire alarm systems; smoke detectors; fire safety

Nober, E. H.; Peirce, H.; Well, A. D.
Waking Effectiveness of Household Smoke and Fire Detection Devices. Final Report.
Massachusetts Univ., Amherst
9 p. January 10, 1983.
fire detection devices; wakefulness; smoke

Nober, E. H.; Peirce, H.; Well, A. D.; Johnson, C. C.; Clifton, C.
Waking Effectiveness of Household Smoke and Fire Detection Devices.
Massachusetts Univ., Amherst
Fire Journal, Vol. 75, No. 4, 86-91,130, July 1981.

NBS-GCR-80-284; 85 p. October 1980.
Available from National Technical Information Services PB80-127565
adults; fire alarm systems; auditory perception; decibel levels; fire departments; noise (sound); sleep; smoke detectors; wakefulness; residential buildings; human behavior
Normal-hearing, young adults were subjected to home smoke detector alarm signals of 85, 70, and 55 dBA while asleep in their own bedrooms under quiet background conditions. In addition, other adults received 70 and 55 dBA alarm signals masked by window air conditioner background noise. Each person, upon awakening from the alarm signal, was instructed to shut off the alarm and telephone the local fire department. The 85, 70, and 55 dBA alarm levels were all sufficient to awaken the subjects at varying hours of the night and days of the week, under quiet background conditions. While there were statistically significant differences in waking times between 55 dBA and the other two alarm levels, the total times never exceeded 115 seconds for the combined alarm shutoff and the fire department telephone call at any alarm level. With background noise, waking times for the 70 and 55 dBA alarm levels increased (85 dBA not tested). At 70 dBA, the total time for the alarm shutoff and the fire department telephone call ranged from 36 to 119 seconds. At 55 dBA, two persons failed to awaken and one person awakened after the four-minute test termination criteria. For the remaining seven persons, the total time for the combined alarm shutoff and the fire department telephone call ranged from 45 to 137 seconds.

Nober, E. H.; Well, A. D.; Moss, S.
Does Light Work As Well As Sound? Smoke Alarms for the Hearing-Impaired.
Massachusetts Univ., Amherst
Fire Journal, Vol. 84, No. 1, 26-28,30, January/February 1990.
lighting equipment; smoke detectors; handicapped; sound (noise)

Ozment, D.

Ozment, D.
Home Fire Detectors: 90% Are Effective.
Minneapolis Fire Inspector
Minnesota Fire Chief, Vol. 12, No. 4, 14,71, March/April 1967.
fire detectors; fire detection systems

Ozment, D.
Minneapolis Enacts Detector Ordinance.
Minneapolis Fire Inspector, MN
Minnesota Fire Chief, Vol. 13, No. 5, 20,29, May/June 1977.
smoke detectors; residential buildings; standards

Pendergrast, R. F.

Pendergrast, R. F.
Deadly Fire Underscores Need for Smoke Detectors.
Northfield Rescue Squad, IL
Fire Chief, Vol. 24, No. 12, 24-26, Dec. 1980.
smoke detectors; home fires

Pucill, P. M.

Pucill, P. M.
Domestic Fire Detectors. Part 1.
AFA-Minerva (EMI) Ltd., England
Fire Surveyor, Vol. 7, No. 3, 33-37, June 1978.
fire detectors; life hazards; reliability

Record

Record
Home Safe Home. Firesafety On the Job Begins With Fire Safety at Home.
Record, Vol. 55, No. 3, 3-8, May/June 1978.
home fires; fire safety; construction; heating; electrical equipment; human beings; fire detection; fire fighting

Salamone, R.

Salamone, R.
Retrofitting High-Rise Dorms With Alarm and Detection Systems.
Cerberus-Pyrotronics, Cedar Knolls, NJ
Fire Journal, Vol. 84, No. 1, 37-39, January/February 1990.
dormitories; fire alarm systems; fire detection systems; fire safety

Schifiliti, R. P.

Schifiliti, R. P.
Designing Fire Alarm Audibility.
Fire Data Systems, Inc., Lowell, MA
Fire Technology, Vol. 24, No. 2, 181-187, May 1988.
Society of Fire Protection Engineers. Fire Detection and Suppression...Today's Technology.
March 9-11, 1987,
Linthicum Heights, MD, 1-20 pp, 1988.
fire alarm systems; fire protection engineering; noise (sound); signals
This paper demonstrates a method for fire protection engineers to estimate the relative effectiveness and cost of various fire alarm alerting systems during the design process.

Shapiro, J. M.

Shapiro, J. M.; Carpenter, D. J., Jr.; Schaenman, P. S.; Stambaugh, H.
Four House Fires That Killed 28 Children.
USFA Fire Investigation Technical Report Series.
TriData Corp., Arlington, VA
Report 020; 85 p. 1989.
home fires; children; death; adults; smoke detectors; wooden structures; escape means
The Summary of Key Issues chart on the following page shows a more detailed comparison of the key aspects of these four fires. Three of the fires exemplify the largest and least easily solved fire safety problem in the United States -- overcrowded homes in poor neighborhoods where the people have had little or no fire safety education and do not maintain smoke detectors. The fourth fire shows it can happen elsewhere, too. Together they represent high hazards that working detectors and escape plans can reduce.

Smith, R. B.

Smith, R. B.
History of Montgomery County's Law.
Fire Marshals Association of North America
Fire Journal, Vol. 71, No. 2, 61,65,79, March 1977.
smoke detectors; residential buildings; legislation

Smith, R. B.
Smoke Detectors in All Dwellings Required by Retroactive Law.
Fire Marshal, Montgomery County, MD
Fire Engineering, Vol. 130, No. 3, 53-54, March 1977.
smoke detectors; residential buildings; legislation

Sultan, M. A.

Sultan, M. A.; Feldman, W. M.
Smoke Alarms in the Home: What Every Physician Should Know.
National Research Council of Canada, Ottawa, Ontario
Canadian Medical Association Journal, Vol. 133, 1207-1210, December 15, 1985.
DBR Paper 1348; NRCC 25332;
smoke detectors
Primary care physicians interested in health education and accident prevention should be knowledgeable about smoke alarms (smoke detectors with built-in alarms). Either ionization or photoelectric smoke alarms can help save lives if they are properly installed and maintained. The number, site and maintenance of smoke alarms in the home and the steps a person should take in the event of a fire are discussed. Considering the rates of death, disability and disfigurement associated with residential fires, early warning devices such as smoke alarms make sense.

U. S. Fire Administration

U. S. Fire Administration
Fire Alarm and Detection Systems for the Hearing Impaired.
Report to Congress.
Fire Administration, Emmitsburg, MD
Public Law 100-476; 25 p. March 21, 1989.
fire alarm systems; fire detection systems; deafness; handicapped; warning systems; life safety; smoke detectors; sleep; standards

Underwriters Laboratories of Canada

Underwriters Laboratories of Canada
Fire Detection in the Home.
Underwriters Labs. of Canada, Ontario
10M-76; 13 p. 1976.
home fires; fire detection

VanGompel, H.

VanGompel, H.
Belgian Hotel Fire Claims 18 Lives.
Brussels Fire Dept., Belgium
Fire International, No. 58, 65-71, Dec. 1977.
hotels; death; fire fighting; fire fighters; fire detection

Wagner, J. P.

Wagner, J. P.
Smoke Detector Characteristics.
Gillette Reserch Inst., Rockville, MD
University of San Francisco. International Conference on Fire Safety, 2nd. Volume 2.
January 24-28, 1977, San Francisco, CA, 432-458 pp, 1977.
fire safety; smoke detectors; ionization detectors; photoelectric detectors; taguchi gas sensor (trademark); residential buildings; tests

Waterman, T. E.

Waterman, T. E.
Detector Response VS Available Escape Time in Residences.
IIT Research Inst., Chicago, IL
Society for Fire Protection Engineers and the National Bureau of Standards. Engineering Applications of Fire Technology Workshop Proceedings. April 16-18, 1980.,

National Bureau of Standards, Gaithersburg, MD, Society for Fire Protection Engineers, Boston, MA, Nelson, H. E., Ed., 25-50 pp, 1983.
fire detectors; escape; residential buildings; smoke detectors

Western, F.

Western, F.
Pre-Planned Fire Safety for the People in Nat West's Tower.
Fire, Vol. 73, No. 910, 551-552, April 1981.
high rise buildings; construction; fire safety; fire detection systems; warning systems

Willey, A. E.

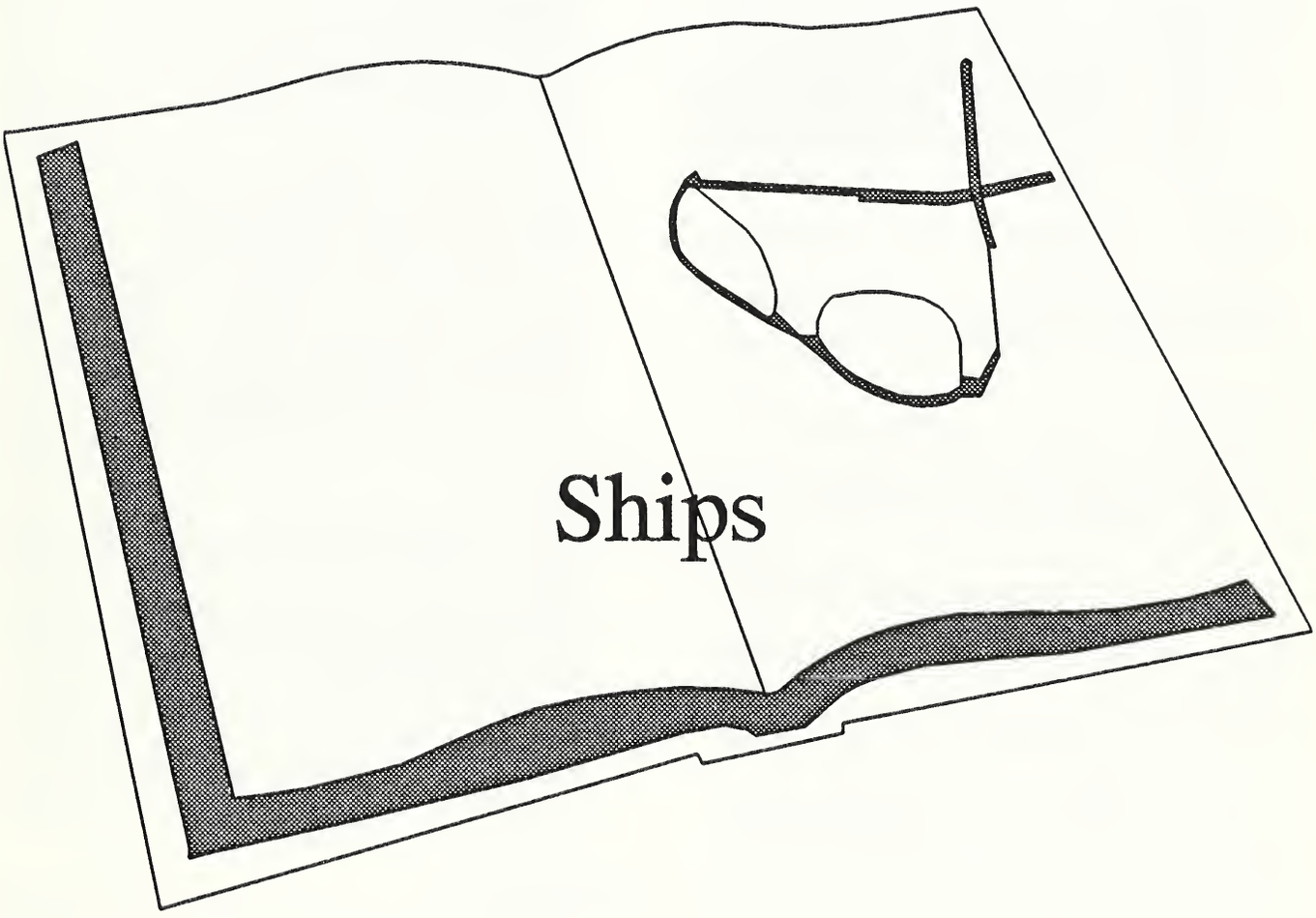
Willey, A. E.
Factors in Unsuccessful Smoke Detector Performance in Residential Occupancies. Preliminary Analysis.
National Fire Protection Assoc., Quincy, MA
Fire Journal, Vol. 73, No. 3, 42-45, April 1979.
smoke detectors; residential buildings; fire statistics; human behavior

Wilson, R.

Wilson, R.; Gomberg, A.
Occupant Risk Method Illustrated By a Study of Occupants in Mobile Home Fires.
Firepro Inc., Wellesley Hills, MA
Firepro Report 101; 69 p. 1978.
mobile homes; fire risks; structures; fire safety; smoke detectors

Winkworth, G.

Winkworth, G.
Cause for Alarm.
Hereford and Worcester Fire Dept., UK
Fire Engineers Journal, Vol. 48, No. 149, 17-18, June 1988.
fire alarm systems; fire protection; safety engineering



Ships

It is intriguing to find that, while there is little new detection technology discussed in the general fire literature, a great deal of effort has been expended in this category. This might be indicative of the fact that the US Navy has been funding work in the past few years when other sources have not. Thus, while there are only a few papers here, most are of interest to developers.

Notable are papers on fiber optic systems [Little *et al* 1990] sensors [Rogers *et al* 1990, Yencha *et al* 1988, 1989, Iverson 1983, Finney 1986, and Pati 1990]. Several papers by Callahan [1989, 1984, 1983] relate to a NAVSEA system using conventional technology which has been plagued with problems; and two by Street [1989 and 1982] discuss a "smart" detector developed at NRL.

Callahan, J. T.

Callahan, J. T.
Fire Signature Measurements in Shipboard Machinery Space Environments. Interim Report.
Naval Ship Engineering Center, Philadelphia, PA
NAVSECPHILAD-A-1623-1; 40 p. April 1979.
LIMITED DISTRIBUTION
Available from National Technical Information Services AD/B-037929
ships; fire detectors; fire protection; fire detection systems; instruments; large scale fire tests

Callahan, J. T.
Shipboard Fire Detection System Selection and Installation Guidance. Interim Report.
Naval Ship Systems Engineering Station, Philadelphia, PA
A-1623-2; 48 p. July 8, 1981.
Available from National Technical Information Services AD/B-058715
fire alarm systems; installing; fire protection; shipboard fires; costs; smoke
Detector types are identified for thirteen general categories of shipboard spaces and for certain specific spaces. Detector selection rationale are given. Fire scenarios are identified for the general shipboard categories. Detector selection and installation guidance, methods for determining detector and switchboard quantities and estimated acquisition and installation costs also are given.

Callahan, J. T.; Ostroff, A. N.
Military Specification for a Shipboard Fire Detection System. Interim Report.
Naval Ship Systems Engineering Station, Philadelphia, PA
A-1623-3; 198 p. July 1981.
Available from National Technical Information Services AD/B-060135
fire detection systems; fire detectors; fire protection; shipboard fires; specifications; large scale fire tests; small scale fire tests; sensitivity analyses; databases

Davies, D.

Davies, D.
Naval Fire Protection for the 1990's.
Graviner, Ltd., United Kingdom
Fire International, No. 105, 39,42-43, June/July 1987.
compartments; carbon dioxide; toxic gases; fire protection; fire suppression; fire fighting; halon 1301; bromotrifluoromethane; shipboard fires
As a result of the South Atlantic campaign, Operation Corporate, the need to review fire fighting procedures was apparent. To be effective against anti-ship missiles, the old concept of fire fighting must be replaced by fully automatic fire "suppression". It would consist of an integrated detection and extinguishing system.

Finney, A.

Finney, A.
Current Trends in Detection Systems On Board Ships.
Lloyds Register of Shipping, London, England
Fire International, Vol. 10, No. 97, 43-45, February/March 1986.
fire detection
Statutory and Classification regulations for fire detection systems on ships are becoming more detailed and stringent. This article discusses advances in fire detection technology.

Heskestad, G.

Heskestad, G.
Modeling Detection of Fire.
Factory Mutual Research Corp., Norwood, MA
Naval Research Laboratory and Naval Sea Systems Command.
Workshop on Fire Modeling and Scaling. December 2-3, 1981, Washington, DC, Naval Research Lab., Washington, DC, Carhart, H., Williams, F., Childs, E. and Quintiere, J. G.,, Editors, 11/1-4 pp, 1981.
fire data; fire detectors

Iverson, M. L.

Iverson, M. L.
Ultrasonic Data Link Measurements. Final Report. October 1977-September 1978.
Naval Weapons Center, China Lake, CA
NWC-TP-6094; 32 p. March 1979.
Available from National Technical Information Services AD/A-066510
ships; steel structures; warning systems; ultrasonics; communications networks

Little, W. R.

Little, W. R.; Otto, D. C.; Denier, C. A.
New Approach to Sensors for Shipboard Use.
Eldec Corp., Bothell, WA
SPIE--The International Society for Optical Engineering.
Fiber Optic Systems for Mobile Platforms. August 20-21, 1987, San Diego, CA, SPIE/Intl. Soc. for Optical Engineering, WA, Vol. 940, Lewis, N. and Moore. E. L., Eds., 72-79 pp, 1987.
ships; sensors; fiber optics; transducers; transformers; flooding
The shipboard environment, with its potential for extreme EMI levels, electrical problems, flooding, fire and other damaging conditions, is particularly well suited to benefit from fiber optic based sensing technology. Eldec Corporation has been involved in the development of such sensors and this paper outlines some of the issues related to that development, including an examination of the particular requirements of shipboard systems and how those requirements affect development of general purpose fiber optic based sensors. The tradeoffs between passive fiber optic transducers and equivalent self-powered electric 'active' devices using fiber optic signal lines are examined. Additionally, a basis for the development of these 'active' sensors will be presented, along with descriptions of a non-contacting limit switch and linear position sensor equivalent in function to the LVDT linear variable differential transformer.

Lugar, J. R.

Lugar, J. R.; Rollhauser, C. M.
Fire-Protection Study of High-Performance Ships.
David W. Taylor Naval Ship R&D Center, Annapolis, MD
MAT-75-46; 36 p. February 1976.
Available from National Technical Information Services AD/A-021939
ships; construction materials; fire detection; fire protection; gas turbine engines

Malkoff, D. B.

Malkoff, D. B.; Moy, M. C.; Williams, H. L.
Computer-Assisted Fault Detection and Recovery: Ship Firemain Systems. Final Report.
Navy Personnel Research and Development Center, San Diego, CA
NPRDC TR 85-31; 41 p. July 1985.
Available from National Technical Information Services AD/B-094306
ships; computers
This report addresses the application of human factors technology in association with state-of-the-art computer and display technologies to shipboard firemain system malfunction detection and recovery. The advantages and disadvantages of differing degrees of automation and central control are explored. The results should be of interest to those concerned with propulsion unit falut-handling, computer control systems, personnel training, ship damage control, and firemain design.

New Scientist

New Scientist
Chemical Detector Prevents Fire Down Below.
New Scientist, Vol. 91, No. 1268, 526, 1981.
ships; electrical faults; ammonia; paints; sensors

Pati, V. B.

Pati, V. B.; Joshi, S. P.; Sowmianarayana, R.; Vedavathi,
M.; Rana, R. K.
Simulation of Intelligent Fire Detection and Alarm System for a Warship.
Institute of Armament Technology, Pune, India
Defence Science Journal, Vol. 9, No. 1, 79-94, 1989.
fire detection systems; fire alarm systems; ships; fire extinguishers; sensors; fiber optics; fire detectors
Fire is one of the major hazards in warships. A warship being a very complex structure, with sophisticated weapons, machinery, fuel and ammunition is always at risk of fire. Restrictions on movement of ship's personnel and equipment requires automation in fire detection and control systems. This paper describes the limitations of conventional fire detection systems, followed by the features of modern fire detection and alarm (the so-called intelligent) systems and the types of fire detectors used in fire detection systems. The experimental set-up used for simulating a simple system having 24 sensors connected to the microcomputer via digital input card is explained in detail with the limitations of the experimental set-up and improvements that can be made by incorporating serial communication in a loop, using fiber optics data links, and intelligent loop/interface units.

Rogers, A. C.

Rogers, A. C.; Johnson, J. E.
Assessment of Shipboard Sensors and Instrumentation. Final Report. September 25, 1979-February 28, 1982.
Southwest Research Institute, San Antonio, TX
MA-RD-920-82047; 455 p. February 1982.
Available from National Technical Information Services PB82-201484
sensors; ships; merchant vessels; temperature measuring instruments; fire detection systems; technology assessment
Shipboard sensors and associated signal conditioning instrumentation used for the measurement and control of pressure, vacuum, temperature, flow, and level limit are generically classified and representative instruments of these classes are assessed through laboratory and design review evaluations. The evaluation procedure is based upon an all-encompassing sensor standard that was written to promote the development of safe and reliable shipboard sensors and instrumentation. Domestic and foreign owners/operators, shipbuilders, classification societies, regulatory agencies, and manufacturers were consulted thorughout this study program and a compendium of their attitudes, opinions, experiences, and recommendations is included and summarized. Major foreign and domestic instrumentation related requlations are presented in a form to identify similarities and dissimilarities between regulatory requirements. The report concludes with recommendations for the implementation and adoption of realistic marine standards for use in specifying sensors and related instrumentation.

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Fuel Loading Design Criteria for Habitability Spaces. Draft.
Rolf Jensen and Associates, Inc., Annandale, VA
W1375.1; 51 p. October 17, 1978.
fuel load; fire protection; fire hoses; fire detection; shipboard fires

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Naval Research Lab., Washington, DC
NRL-MR-3680; Project F43451; 30 p. December 1977.
Available from National Technical Information Services AD/A-053845
fire detectors; ionization detectors; reliability; test methods; smoke detectors; shipboard fires; stability; fire tests

Street, T. T.; Lawrence, K. D.; Williams, F. W.; Alexander, J. I.
NRL Processor-Aided Fire Detection System.
Naval Research Lab., Washington, DC
NRL Report 8341; 116 p. September 14, 1979.
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fire detection systems; fire detectors; smoke; prototypes; test methods; fire alarm systems; sampling; reliability; shipboard fires; fuels; stability; fire tests; smoke detectors
A series of fire tests has been conducted simulating shipboard environments. During these tests an NRL prototype fire detection system was compared to two commercial fire detectors. The detectors were exposed to various fuel-type fires inolving both solids and liquids, and to different humidity and temperature conditions. Comparative results for 100 experiments are presented. The reliability of the detectors also is examined.

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Logic Aided Fire Detection System.
Naval Research Lab., Washington, DC
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fire detection systems; fire detectors

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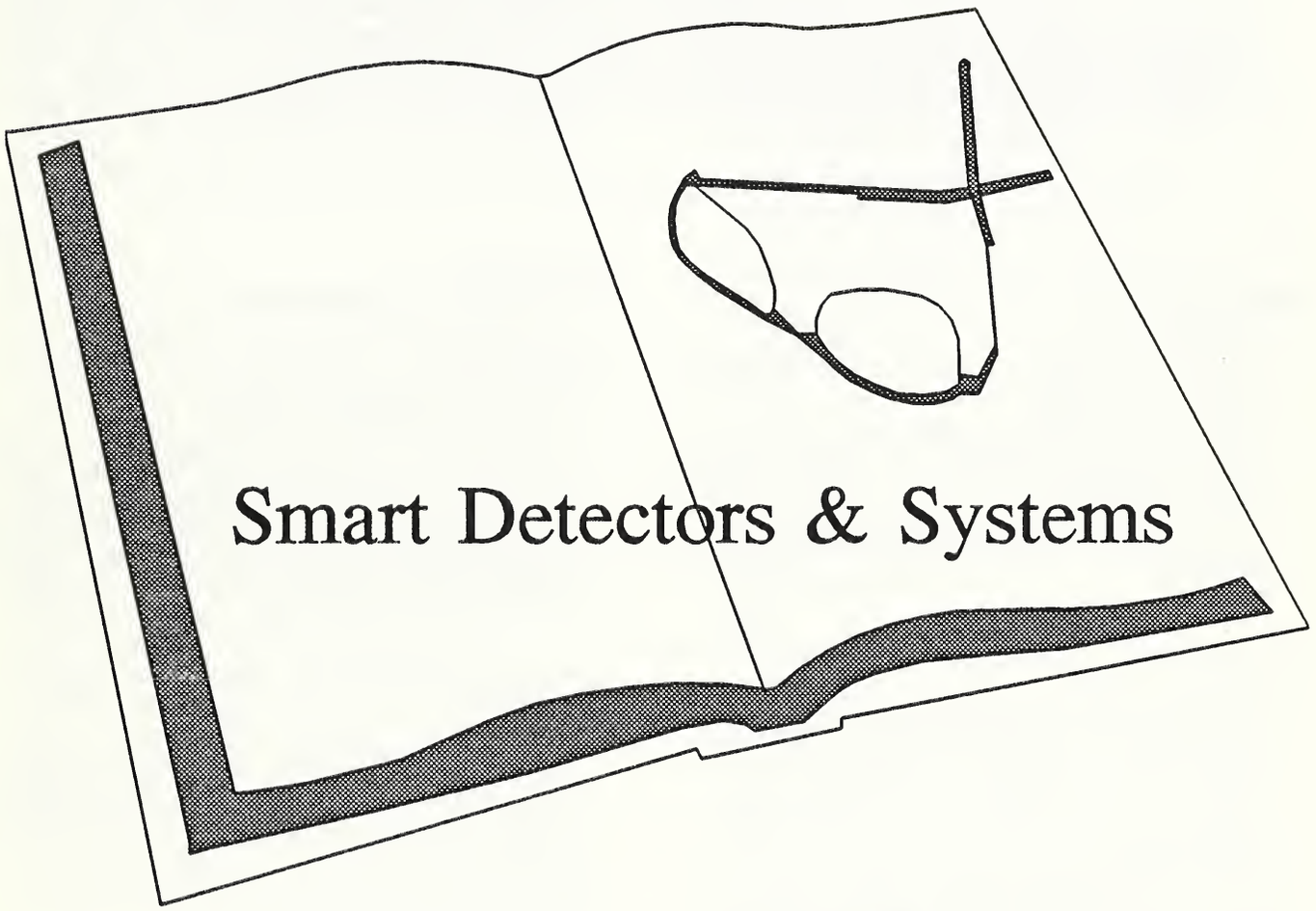
Williams, F. A.; Corlett, R. C.; Alger, R. S.
Status Review of Experimental Modeling of Shipboard Fires.
California Univ., San Diego
Fireline, 7-11, January 1977.
shipboard fires; scaling; fire detection; smoke; toxic gases; fire suppression; fire damage; fuel beds

Yencha, T. J.

Yencha, T. J.; Rumuly, D. L.
Shipboard (CV, FFG, DD, DDG, and AO) Testing of the Automatic Chemical Agent Alarm Set (Ionization and Enzymatic Detectors).
Naval Surface Weapons Center, Dahlgren, VA
NSWC TR 82-403; Project S0410SL; 18 p. November 1982.
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ionization detectors; chemical agents; false alarms; shipboard fires; tests

Yencha, T. J.; Rumuly, D. L.; Buhmann, K. A.
Shipboard (DD and CVA) Testing of the Automatic Chemical Agent Alarm Set (Ionization Detector and M43E2). Final Report.
Naval Surface Weapons Center, Dahlgren, VA
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Available from National Technical Information Services AD/B-065794
ships; helicopters; ionization detectors; chemical agents; chemical warfare; test methods; false alarms; tests

International Fire Detection
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Smart Detectors & Systems

While the US industry was focussed on addressable detectors, the European and Japanese were developing "smart" systems - typically analog detectors mated to computers which discriminate real fires from interference signals using algorithms. Now that the US systems are advancing to this point, it is beneficial to review the foreign experience with such systems to prevent our duplicating their mistakes. The collection of papers in this topic will serve just that purpose.

There are many papers in this section which describe the approach used in Europe and Japan [Faulkner 1990, Vesin 1989, Smithiers *et al* 1989, Capaul 1989, Ellwood 1989, Pigott 1979, 1983, 1986, 1987, and 1989, Holland *et al* 1981, Lets 1982 and 1988, Luck *et al* 1984 and 1986, Cerberus 1990, Scheidweiler 1984, Von Tomkewitsch 1984, Holker 1986, Anderson 1986, Okayama 1989, Unoki 1990, Ono *et al* 1990, Ishii *et al* 1989, BRI 1984, and Unoki *et al* 1984].

There is a thorough paper by Factory Mutual [Heskestad and Newman 1990] outlining a signal correlation technique for reducing false alarms and several by Japanese which explore new sensors [Hotta *et al* 1990, Okayama *et al* 1990] or combinations of sensors [Kouzeki and Satoh 1990] used to increase the amount of data available on which to decide if there is an unwanted fire. There is another Japanese application of *fuzzy logic* to analog detector decision algorithms [Nakanishi *et al* 1990] which should be reviewed.

Anderson, D. D.

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Fire Alarm/Detection Systems: Keeping Up On Today's Technology.
Notifier/Fire-Lite Alarms Inc., New Haven, CT
Consulting/Specifying Engineer, Vol. 3, No. 4, 48-51, April 1988.
fire alarm systems; fire detection systems; technology utilization

Anderson, D. D.
Ideal Smoke Detection System With Special Considerations for Installation and Testing.
Simplex Time Recorder Co., Gardner, MA
ASHRAE Transactions, Vol. 91, No. 2, 36-40, 1985. HI-85-23 No. 4;
smoke detection
New Electronic Technology makes possible a smoke detection system which is superior to most systems in use today. Significant advantages are identified in simplified installation requirements, superior system testing, better supervision of interconnection wiring and detectors, and improved system performance. The Smart Detection System, as described, is based on smoke detectors that communicate individually with a computer-based central control panel. Each detector sends, on command, an analog measurement of the smoke level in its chamber to the central control panel. Using special software routines, the control panel processes these measurements to determine smoke alarm or maintenance requirements.

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University of Duisburg. International Conference on Automatic Fire Detection "AUBE '89", 9th. September 26-28, 1989, Duisburg, West Germany, Luck, H., Ed., 101-115 pp, 1989.
fire detection; fire detection systems; fire alarm systems; reliability; analog computers

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Sprinkler System Design: Past, Present, Future.
Grinnell Fire Protection Systems, Providence, RI
Specifying Engineer, Vol. 37, No. 6, 94-99, May 1977.
fire detection systems; design applications; smoke detectors; fire detectors; flame detectors

Borremans, A. A. M.

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Publishers, NY, Mourareau, R. and Thomas, M., Editors, 374-382 pp, 1985.
fire protection; fire detection; fire alarm systems; fire fighting; fire detectors; technology utilization; smoke detectors

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Computer Assisted Risk Evaluation--A Practical Application to Risk Management Decisions Using Engineering Judgment.
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computers; risk management; fire protection; computer models; fire detection systems

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fire hazards; fire safety; subways
A fire hazard evaluation of the subway cars used on the San Francisco Bay Area Rapid Transit District was performed. After analyzing the cars' interior and exterior design, five recommendations were made that, if implemented, would improve passenger safety by decreasing the probability of developing a hazardous fire situation. Among these recommendations were the upgrading of current upholstered urethane seat assemblies and the need for the development of a fire detection system appropriate for rapid rail transit vehicles. Those system improvements would not only provide passengers a safer traveling environment but would also provide a modest level of protection for the heavy investment in rail vehicles.

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Building Research Inst., Garston, UK
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fire detection systems; false alarms; computers

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Fire Research Station, Borehamwood, England
University of Edinburgh. Recent Developments in Fire Detection and Suppression Systems. (With Additional Papers From a Course of the Same Title--July 8-9, 1987). November 10-12, 1986, Edinburgh, Scotland, 5 pp, 1987.
fire detection; fire research

Capaul, T.

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MIREX, ein neues optisches Rauchdichte-Messgerat nach dem Extinktionsprinzip [MIREX, a new Optical Smoke Measuring Instrument based on the Extinction Principal]
Cerberus AG, Mannedorf, Switzerland
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '89", 9th. September 26-28, 1989, Duisburg, West Germany, Luck, H., Ed., 765-774 pp, 1989.
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Specifying Engineer, Vol. 51, No. 5, 66-68, May 1984.
fire alarm systems

Cerberus

Cerberus
Remote Monitoring Today.
Alarme--Modern Fire Protection and Security Systems Review, No. 105, 1-3, November 1988.
monitors; fire alarm systems; sensors
Literally from our earliest childhood we are familiar with the idea of keeping an ear open for the baby next door with the help of an intercom or babyphone. It meant that the neighbours could have an undisturbed evening out occasionally. These days there are thousands of other "objects" to be kept under surveillance, ranging from the heating plant to the intrusion detection system, from the lift to the refrigerators or freezers, from the pub and its one-armed bandits to the warehouse and the computer system. These things usually operate automatically, and here too, we only expect to hear something from them if something out of the ordinary happens.

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New Laser Source for Radical Detection in Flames.
Sandia Labs., Livermore, CA
18 p. April 2-3, 1984.
Combustion Institute/Western States Section. Spring Meeting, 1984, WSS/CI 84-31, Boulder, CO, 1984.
detection; lasers; low pressure flames
A new laser source has been developed with permits detection of species which have absorption lines in the region of 410 nm to 360 nm. Some of the more interesting combustion species absorbing in this region are CN, CH, and C2. In order to determine the sensitivity and applicability of this new laser source, fluorescence excitation spectra of CN and CH were obtained in a low pressure flame where the calculated concentrations of CN are below 10 parts per million. Laser induced fluorescence (LIF) spectra were used to determine concentration profiles of these species and the temperature in the flames. From absorption spectra of CH and CN approximate values for the absolute concentrations were determined.

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Plant/Operations Progress, Vol. 8, No. 1, 12-18, January 1989.
fire detection; sensors; fire protection

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Ein Wirksamkeitsmass fur Signaldetektoren. [On the Determination of the Efficacy of Signal Detectors.]
Duisburg Univ., Germany
AEU Band, Vol. 34, No. 9, 353-360, 1980.
In: German
false alarms; signal detection
In this paper an efficacy measure for signal detectors is considered. This measure doesn't take into account only the usual values of detection probability gamma and false alarm probability alpha but also the time between suceeding decisions. First a general detector is described with the characteristics of time which contributes to its decisions. With this general detector the decision mechanism of any detector can be described. The calculation of this efficacy measure is based on the meantime between alarms, which is a function of the detection probability, the false alarm probability and the time between succeeding decisions. The meantime between detections and the meantime between the false alarms is calculated as a function of the meantime between alarms. These are the important parameters which determine the efficacy measure.

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smoke detectors; warning systems; light extinction; fire alarm systems

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fire detection systems; standards; regulations; technology utilization

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fire detectors; false alarms; fire detection systems

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Detecting Changes in Sensor Design.
Thorn EMI Protech
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sensors; fire detection systems; infrared fire detectors; false alarms

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Alarms and Safety Offshore.
Control and Instrumentation, Vol. 8, 26-27, July/August 1976.
offshore platforms; fire alarm systems; fire detection; fire detection systems; damage control; smoke detectors
After briefly discussing fire and explosion hazards on oil production platforms, the author describes a new system developed by his firm, GP-Elliott Electronic Systems Ltd. for monitoring and giving early warning of possible sources of ignition (such as smoke, flame, or overheating of electrical equipment) monitoring the presence of flammable gas, and depending on the circumstances, automatically closing vents, shutting down plant, and operating the extinguishant. The system has been developed from the company's Fire/Gas Display and Control System, which has been installed in a number of programmable modular solid-state systems which use COSMOS logic elements, can be arranged to suit the requirements of the largest installations. Collecting and processing the information from the system's sensing devices is carried out in a console in the main control centre of the platform; the information displayed on the console matrix is transmitted for display on satellite panels in various parts of the platform, and the console as necessary, actuates the alarms and initiates the fire-fighting action. The article gives further information on the system and its equipment, and includes a simplified block diagram.

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fire detection; false alarms; heat detection; fire tests; sensors; algorithms

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fire alarm systems; fire detection systems

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fire detection systems; fire alarm systems

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New Ultraviolet Flame Detector.
Fire, Vol. 77, No. 966, 45, December 1985.
flame detectors; ultraviolet detectors; fire alarm systems

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fire protection; fire detectors; pressurization; sprinklers

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Fire Fighting in Canada, Vol. 23, No. 5, 14,16, October/November 1979.
fire detection systems; television; cables

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Fire Prevention
Detecting Alternatives.
Fire Prevention, No. 238, 26-28, April 1991.
smoke detectors; ionization chamber detectors; fire detectors
Since their introduction in the late 1950's, ion-chamber smoke detectors have dominted the early warning fire detection market to the extent that today they probably account for over 90 percent of installed detectors.

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Schirmer Engineering Co., Glenview, IL
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signals; signal detection; design applications; cost effectiveness; transmission

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Technical Report.
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Japanese Association of Fire Science and Engineering. Fire Research Annual Conference. May 17-18, 1990, 69-72 pp, 1990.
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fire research; smoke; false alarms
Using particle make-up to prevent false alarms is discussed. By shining a multi-wavelength light through particles, extinction coefficients are found. The extinction coefficients are compared and the particle determined. The extinction multiplier ratio varies according to the smoke particle type. If the ratio falls within a certain range, fire and false alarms can be differentiated.

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fire protection; light scattering detectors
An infrared emitting diode (IRED) is described; the spatial intensity distribution of the radiation is adjusted to a light scattering smoke detector. This new design allows light sources with increased optical efficiency and high reliability characteristics.

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Annual Conference. May 17-18, 1989, Tokyo, Japan, 39-40 pp, 1989.
In: Japanese (Abstract in English)
fire detectors; sensors
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March 5-6, 1975, 111-126 pp, 1975.
carbon dioxide; fire detection; fire suppresstion; heat detection; smoke detection; flame detection
The use of automatic fire detectors to trigger fire extinguishment systems has gone on for many years. Systems of this type use a variety of extinguishing agents including water, carbon dioxide and, most recently, the halogenated agents. Automatic extinguishing systems with practically an unlimited supply of agent suffer from the fact that these systems often continue in operation long after the fire is out resulting in additional damage. This doesn't occur with those systems having limited supplies such as carbon dioxide systems and the like. However, these systems are only successful if: (1) their original design was correct; (2) no unanticipated changes are made in the area or materials to be protected; and (3) extinguishment commences at a time when successful extinguishment is possible. This paper describes how the disadvantages recommended above can be avoided, to a large extent, with a modified design for permanently-installed, automatic extinguishing systems and how systems can be provided which will only discarge extinguishant at the proper time and in the proper amount.

Lecuyer, D.

Lecuyer, D.
L'utilsation des techniques logicielles dans les systemes de detection incendie. [Use of Logic Techniques in Fire Detection Systems.]
La Detection Electronique Francaise S.A., Vanves, France
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '82", 8th. Probleme der automatischen brandentdeckung. October 5-7, 1982, Duisburg, West Germany, Luck, H., Ed., 406-411 pp, 1982.
In: French
fire detection systems

Lee, B. M.

Lee, B. M.
New Developments in Fixed Systems.
Wormald International Pty., Ltd., Australia
Fire Engineers Journal, Vol. 38, No. 111, 11-14, September 1978.
sprinkler systems; fire suppression; water distribution; droplet size; water sprays; fire detection

Lets, J. B.

Lets, J. B.
Fire Detection--The Opportunities Offered by New Generation Fire Detection and Alarm Systems.
Gent Ltd., Leicestrer, England
Fire and Materials, Vol. 13, 1-315, March 1988.
Interflam '88. Research Into Practice. 4th International Fire Conference. Conference Workbook. Organized Jointly by Interflam Conferences Ltd. and the Fire Research Station of the Building Research Establishment, in Association With the Royal Institute of British Architects and With EEC Recognition. March 22-24, 1988., Cambridge, England, John Wiley and Sons, New York, Rogers, S. P. and Quarterman, R. M., Editors, 148-155 pp, 1988.
fire detection; fire alarm systems

Letts, J.

Letts, J.
Fire Alarm Control and Indicating Equipment.
Fire Surveyor, Vol. 11, No. 4, 25-33, Aug. 1982.
fire alarm systems; fire detection

Letts, J.
New Generation and Traditional Fire Alarm Systems.
Gent Limited, England
Fire Surveyor, Vol. 15, No. 1, 4-10, Feb. 1986.
fire alarm systems
For the last two or three years, the most talked about advance in fire detection and alarm systems has, without doubt, been 'Intelligent' systems. They offer the promise of improved performance, higher reliability and often incorporate the very latest developments in electronic circuits and components. While much has been written in *Fire Surveyor* on the design and facilities offered, there is the possibility that these new systems will be specified just because they are new, and not because they are necessary. This article explains what they may offer and how they relate to the facilities offered by traditional systems. This may assist the system specifier in defining the system characteristics that are required, and thus judge whether an 'Intelligent' system is a necessity or whether a suitability configured traditional system would adequately provide the requisite facilities.

Levy, D.

Levy, D.
Disappear Into the Woodwork With Radio-Based Fire Detection Systems.
RAFT Ltd.
Fire Prevention, No. 225, 33-35, December 1989.
fire detection systems; historic buildings; fire safety; wires; fire protection

Loyd, R. A.

Loyd, R. A.
Ultra High Speed Deluge Systems for Ordnance Operations.
Army Armament, Munitions and Chemical Command Safety Office, Rock Island, IL
Federal Fire Forum. Special Types of Fire Protection.
November 3, 1989, 1-82 pp, 1989.
deluge systems; flame detectors; valves; pipes; nozzles; water supply; ultraviolet detectors; infrared detectors

Luck, H. O.

Luck, H. O.
Correlation Filters for Automatic Fire Detection Systems.
Duisburg Univ., West Germany
International Association for Fire Safety Science. Fire Safety Science. Proceedings. 1st International Symposium.
October 7-11, 1985., Gaithersburg, MD, Hemisphere Publishing Corp., NY, Grant, C. E. and Pagni, P. J.,, Editor, 749-758 pp, 1986.
fire detectors; fire detection systems

Luck, H. O.; Brockmann, T.; Schlossarek, U.
New Technologies in Automatic Detector and Suppression.
Duisburg Univ., West Germany
New Technology to Reduce Fire Losses and Costs. October 2-3, 1986, Luxembourg, Elsevier Applied Science Publishers, NY, Grayson, S. J. and Smith, D. A., Editors, 211-226 pp, 1986.
fire detection systems; fire suppression

Luck, H. O.; Hase, K. R.
Signal Detection Aspects in Automatic Fire Detection.
Duisburg Univ., Federal Republic of Germany
Fire Safety Journal, Vol. 6, No. 3, 233-240, 1983.
fire detectors; signal detection; algorithms; simulation

Luck, H. O.; Schlossarek, U.
Software Controlled Fire Detection Systems--Design and Testing.
Duisburg Univ., Germany
Fire Science and Technology, Vol. 7, No. 2, 53-60, 1987.
fire detection systems; computer programs; design applications

Lundstrom, I.

Lundstrom, I.; Shivaraman, M. S.; Stiblert, L.; Svensson, C.
Hydrogen in Smoke Detected by the Pd-Gate Field-Effect Transistor.
Chalmers Univ. of Technology, Gothenburg, Sweden
Review of Scientific Instruments, Vol. 47, No. 6, 738-740, June 1976.
hydrogen; smoke; fire alarm systems
A recently developed hydrogen-sensitive Pd-gate MOS-transitor was used to detect small amounts of hydrogen in smoke. It is shown that the device can be used to detect a fire before it has really started and therefore has a potential application as a fire alarm.

Lynch, D.

Lynch, D.
Cable TV System Detects, Reports Fire in Homes.
Fire Engineering, Vol. 131, No. 9, 35-36, September 1978.
home fires; television; cables; fire detection; fire alarm systems

Maillet, M.

Maillet, M.
Microprocessors and New Communication Systems in Improved Detection Systems.
Euralarm, France
New Technology to Reduce Fire Losses and Costs. October 2-3, 1986, Luxembourg, Elsevier Applied Science Publishers, NY, Grayson, S. J. and Smith, D. A., Editors, 243-247 pp, 1986.
fire detection

Martin, K.

Martin, K.
Rauchmelder der neuen Generation auf dem Prufstand. [New Generation Smoke Detectors on the Test Bench.]
Allianz Versicherungs-AG, Munchen, West Germany
Der Maschinenschaden, Vol. 56, No. 6, 241-243, 1983.
In: German
smoke detectors; ionization detectors; smoldering; wood; paper; cables; synthetic fibers

Melhuish, C.

Melhuish, C.
Fast-Tracking--The Fire and Security Perspective.
Thorn Security
Fire Prevention, No. 214, 31-32, Nov. 1988.
building construction; fire detectors; construction; management

Middleton, J.

Middleton, J.
New Generation Conventional Systems Each Have Their Merits.
Thorn EMI Protech Ltd., England
Fire Surveyor, Vol. 15, No. 6, 5-7, Dec. 1986.
fire detection systems; false alarms; fire protection; fire fighters
This article points out that despite the advantages addressable fire detection systems have for some applications, conventional zonal systems can provide the same level of protection for many buildings.

Moliere, G.

Moliere, G.
Securite des systemes de detection automatiques d'incendie.
[Security of Automatic Fire Detection Systems.]
C. N. P. P.
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '82", 8th. Probleme der automatischen brandentdeckung. October 5-7, 1982, Duisburg, West Germany, Luck, H., Ed., 224-237 pp, 1982.
In: French
fire detection systems

Mortimer, A.

Mortimer, A.
Gathering Intelligence on Fire Detection Systems.
Autronica Industrial Ltd.
Fire Prevention, No. 231, 32-33, July/Aug. 1990.
fire detection systems; false alarms

Nakanishi, S.

Nakanishi, S.; Kurio, T.; Kaneda, M.; Nomura, J.; Sato, K.; Takemoto, A.; Kouzeki, D.
Fuzzy Experiment System for Fire Judgment.
Japanese Association of Fire Science and Engineering. Fire Research Annual Conference. May 17-18, 1990, 59-62 pp, 1990.
In: Japanese (Abstract in English)

fire research; expert systems
A prototype is developed, introducing expert system and fuzzy inference technology, which can evaluate and distinguish between fire, tobacco smoke, and moisture. Some characteristics it incorporated are several different sensors, a knowledge base and a reasoning function using if-then statements to evaluate the presence of fire.

Naya, K.

Naya, K.; Arai, Y.; Segawa, H.; Sato, H.;Muta, K.
New Proposal of Fire Detection Method by Detecting Signals From Several Infrared Bands.
Japanese Association of Fire Science and Engineering. Fire Research Annual Conference. May 17-18, 1990, 75-78 pp, 1990.
In: Japanese (Abstract in English)
fire research; fire detection; signal detection; carbon dioxide
Infrared type fire detectors detect resonance CO2 radiation given off by flame and combustion. By detecting infrared rays in several wave lengths, fire combustion temperature, combustion area, and the presence of fire were detected. From this information, a new fire detection formula to judge fire presence was devised and tests conducted. It is possible to detect changes in fire from the CO2 ratio.

Okayama, Y.

Okayama, Y.
Primitive Study on Fire Detection Method Controlled by Artificial Neural Net.
Nohmi Bosai Ltd., Tokyo, Japan
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '89", 9th. September 26-28, 1989, Duisburg, West Germany, Luck, H., Editor, 409-432 pp, 1989.
fire detection; analog computers; case histories; sensors; fire probability

Ono, T.

Ono, T.; Aoyama, R.; Ishii, H.; Muroi, T.
Judgment Algorithms for Detecting Fire in the Early Stage Based on Sensor Response.
Nippon Univ., Tokyo, Japan
Japanese Association of Fire Science and Engineering.
Annual Conference. May 22-23, 1984, Tokyo, Japan, 73-74 pp, 1984.
In: Japanese (Abstract in English)
algorithms; sensors
Tests on constructing a judgment management system to correctly evaluate a fire by its levels in the early stage, taking room size into account were made. Time to reach dangerous levels and early fire stage using three sensor reactions is predicted.

Ono, T.; Ishii, H.; Aoyama, R.; Muroi, T.
Basic Study on the Intelligenation of Fire Detecting Systems. Part 1. Correction for Response on Frequency and Compartment Geometry.
Nippon Univ., Japan
Japanese Association of Fire Science and Engineering.
Annual Conference. May 29-30, 1985, Tokyo, Japan, 21-22 pp, 1985.
In: Japanese (Abstract in English)
compartments
Analysis of wave frequency in the early fire stages when smoke and heat spread diffused. Study on adjusting for room conditions which clearly have an effect on wave frequency and sensor response.

Ono, T.; Ishii, H.; Matsumoto, A.; Muroi, T.
Basic Research on the Intelligenation of Fire Detection Systems. Part 2. Compensation for Compartment Size.
Nippon Univ., Japan
Japanese Association of Fire Science and Engineering. Annual Conference. May 20-22, 1986, Tokyo, Japan, 69-70 pp, 1986.
In: Japanese (Abstract in English)
compartments
Because CO gas and smoke are easily diffused, ionization and smoke sensor output varies by room size while heat sensor output appears not to be influenced. By using several formulas, a coefficient to compensate for room size is determined and introduced into fire evaluation algorithms. Applications of these algorithms in fire testing made better evaluations possible.

Ono, T.; Ishii, H.; Muroi, N.
Frequency Response Required for an Intelligent Fire Alarm System.
Nihon Univ., Tokyo, Japan
Bulletin of Japanese Association of Fire Science and Engineering, Vol. 35, No. 2, 23-30, 1986.
In: Japanese (English Abstract)
fire alarm systems; response time; sensors; response time
In order to detect a compartment fire in the early stage and provide highly reliable fire information, it is necessary first to sense the fire phenomena as they change moment by moment and then make a judgment about the fire based on the data obtained. The time-domain data of a fire cannot be attained by conventional sensors which are actuated at a fixed threshold level. To obtain such data, analog output type sensors should be used. However, because the behavior of a fire is not usually steady in the

course of its progression, the main stream of the fire phenomena may not be precisely extracted if the analog sensor output data are used as they are for fire judgment. In the design of an intelligent fire alarm system, therefore, consideration should be given to the frequency response of the system. Using the results of the analysis of the output data of temperature sensors and smoke sensors obtained from fire experiments, we have investigated the frequency response required for the intelligent system. Our results show that in the early stage of a fire, the main frequency components of the fire phenomena in the course of its progression fall into the frequency band of from DC to 44 mHz for the temperature and from DC to 15 mHz for the smoke density. This implies that the temperature sensor output and the smoke sensor output should be filtered individually through these frequency bands. We also investigated the requirements for digital filters that give the above frequency responses, and have clarified the relationship between the frequency response of the sensor itself, the cut-off frequency of the digital filter, and the data sampling interval. The study shows that precise fire judgment can be made by an intelligent system where the sensor output data are preprocessed, as described above, before being sent to the fire judgment algorithm.

Ono, T.; Ishii, H.; Tanaka, S.
Judgment Procedure for the Early Stage of Fire Based on Three-Dimensional Display Composed With Temperature, Smoke, and CO Gas.
Nippon Univ., Japan
Japanese Association of Fire Science and Engineering.
Annual Conference. May 19-20, 1988, Tokyo, Japan, 5-8 pp, 1988.
In: Japanese (Abstract in English)
temperature; smoke; carbon monoxide
Based on the CO gas, temperature, and smoke emitted from a fire, the position vector loci and the position vectorgiven by the loci to evaluate the fire was estimated.

Ono, T.; Tanaka, S.; Ishii, H.
Vector Expression of Heat, Smoke, and CO Gas in Early Fire Stages.
Japanese Association of Fire Science and Engineering. Fire Research Annual Conference. May 17-18, 1990, 65-66 pp, 1990.
In: Japanese (Abstract in English)
fire research; carbon monoxide; smoke
Heat, smoke, and CO gas are expressed as vector loci. The vector loci must all reach certain levels within a certain time frame to represent a real fire. If even one falls short, then it is a false alarm.

Ono, T.; Tanaka, S.; Ishii, H.; Muroi, T.
Judgment Procedure for the Early Stage of a Fire Based on the Estimation of Time Variation of Three-Dimensional Vector Display Consisting of Temperature, Smoke and CO Gas.
Nippon Univ., Tokyo, Japan
Japanese Association of Fire Science and Engineering.
Annual Conference. May 17-18, 1989, Tokyo, Japan, 45-46 pp, 1989.
In: Japanese (Abstract in English)
temperature; smoke; carbon monoxide
Time variation (estimated time for heat, smoke and CO levels to reach a dangerous fire level) and 3-D display (the progression of the position vector loci in a three dimensional space where each dimension represents heat, smoke and CO output) are combined in a flow chart to outline the conditions necessary to trigger an alarm in the case of fire.

Oram, D. O.

Oram, D. O.; Rodriques, D. J.
Design of Software-Based Fire Alarm Systems.
Simplex Time Recorder Co., Gardner, MA
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '89", 9th. September 26-28, 1989, Duisburg, West Germany, Luck, H., Editor, 75-99 pp, 1989.
fire detection; fire alarm systems; computer programs; fire detection systems; reliability

Pati, V. B.

Pati, V. B.; Joshi, S. P.; Sowmianarayanan, R.; Vedavathi, M.; Rana, R. K.
Simulation of Intelligent Fire Detection and Alarm System for a Warship.
Institute of Armament Technology, Pune, India
Defence Science Journal, Vol. 39, No. 1, 79-94, 1989.
ships; fire alarm systems; fire extinguishers; simulation; sensors; fiber optics; fire detection systems; fire detectors
Fire is one of the major hazards in warships. A warship being a very complex structure, with sophisticated weapons, machinery, fuel and ammunition is always at risk of fire. Restrictions on movement of ship's personnel and equipment requires automation in fire detection and control systems. This paper describes the limitations of conventional fire detection systems, followed by the features of modern fire detection and alarm (the so-called intelligent) systems and the types of fire detectors used in fire detection systems. The experimental set-up used for simulating a simple system having 24 sensors connected to the microcomputer via digital input card is explained in

detail with the limitations of the experimental set-up and improvements that can be made by incorporating serial communication in a loop, using fiber optics data links, and intelligent loop/interface units.

Pease, R. A.

Pease, R. A.
Smoke Detector Chip Makes Low-Cost Temperature Alarm.
National Semicond Corp., Santa Clara, CA
Electronic Design, Vol. 29, No. 22, 198,200, October 29, 1981.
smoke detectors; fire alarm systems

Pigott, B. B.

Pigott, B. B.
Computer Control for Automatic Detectors: A Look Into the Future.
Fire Research Station, Borehamwood, England
Fire, Vol. 71, No. 887, 617-618, May 1979.
computers; false alarms

Pigott, B. B.
Computer-Based Analogue Fire Detection Systems.
Fire Research Station, Borehamwood, England
Fire Engineers Journal, Vol. 43, No. 128, 23-26, March 1983.
fire detection systems; computers

Pigott, B. B.
Potential of Computer Based Analog Fire Sensing.
Fire Research Station, Borehamwood, England
University of Duisburg. 8th International Conference on Automatic Fire Detection "AUBE '82". Probleme der automatischen brandentdeckung. October 5-7, 1982, Duisburg, West Germany, Luck, H., Editor, 320-334 pp, 1982.
fire detection; analog computers; fire detection systems; false alarms; fire alarm systems; wires; reliability; flexibility

Pigott, B. B.
Scope for Intelligent Fire Detection Systems.
Fire Research Station, Borehamwood, England
Paper 2; 21 p. 1986.
fire detection systems; fire fighting; computers; maintenance; human behavior

Pigott, B. B.
Systems Approach to Automatic Fire Detection Using Existing Computing and Electronics Techniques.
Fire Research Station, Borehamwood, England
Coventry Area Health Authority. Fire Safety in Health Care Buildings. November 6, 1980, Coventry, England, 41-63 pp, 1980.
fire detection; systems engineering; computation; electronics; fire alarm systems; fire statistics; hospitals; casualties

Pigott, B. B.
Systems Approach to Automatic Fire Detection.
Fire Research Station, Borehamwood, England
Fire Prevention, No. 149, 29-24, May 1982.
systems analysis; fire detection; fire detectors

Pigott, B. B.
Towards an Intelligent Automatic Fire Detection System.
Fire Research Station, Borehamwood, England
International Conference on Flammability. INTERFLAM '85.
Conference Workbook. March 26-29, 1985., Guildford, England, 305-312 pp, 1985.
fire detection systems
The paper defines 'intelligence' in terms of information processing capability and sets bounds to it by describing readily available hardware capability for zoned, simple multiplex and 'analogue' systems. The static and dynamic information, on which intelligence can be based, is described. The paper then develops the use of this information for maintenance fault diagnosis, system tests and fire detection. Reference is made to one of the current problems of standards committees--should mixed systems be permitted. The author's view is that, given adequate safeguards, which he defines, they should. The paper deals with the problem of human interaction with building occupants and introduces a new approach to communication with fire brigades. The paper closes with speculations for the future.

Plank, K. L.

Plank, K. L.
Neue Kommunikationsnetze fur die Gefahrenmeldetechnik.
[New Communication Nets for the Transfer of Warning Messages.]
RWTH Aachen, Germany

University of Duisburg. International Conference on Automatic Fire Detection "AUBE '89", 9th. September 26-28, 1989, Duisburg, West Germany, Luck, H., Editor, 467-477 pp, 1989.
In: German
fire detection

Redding, R. J.

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Sound Beams for Fire Alarm and Gas Detection Systems.
Design Automation Ltd., London, England
Fire, Vol. 72, No. 897, 532-533, March 1980.
fire alarm systems; gas detectors; ultrasonics

Robinson, D. A.

Robinson, D. A.
Sound Attenuation in Buildings: Implications for Fire Alarm System Design.
Environmental Health and Safety, Amherst, MA
Fire Safety Journal, Vol. 14, No. 1&2, 5-12, July 1, 1988.
Society of Fire Protection Engineers. Fire Detection and Suppression...Today's Technology. March 9-11, 1987, Linthicum Heights, MD, 1-15 pp, 1988.
fire alarm systems; attenuation; buildings; building design; absorptivity; decibel levels; pressure effects; noise (sound); signal detection This paper examines issues related to the attenuation of audible fire alarm signals in buildings and reviews the performance of room mounted audible fire alarm signaling devices in a university residential building.

Sancholuz, A. G.

Sancholuz, A. G.
Oblique Orientation Augments UV Detector Coverage Area.
VENIN Ingenieria, S.A., Caracas, Venezuela
Fire Technology, Vol. 24, No. 2, 100-109, May 1988.
fire detectors; sensors; ultraviolet detectors

Schade, O. H., Jr.

Schade, O. H., Jr.
BiMOS Micropower IC's.
RCA, Somerville, NJ
IEEE Journal of Solid-State Circuits, Vol. SC-13, No. 6, 791-798, December 1978.
integrated circuits; smoke detectors
The BiMOS design approach can be beneficial in the construction of a very large smoke detector.

Scheidweiler, A.

Scheidweiler, A.
Distribution of Intelligence in Future Fire Detection Systems.
Cerberus AG, Mannedorf, Switzerland
Fire Safety Journal, Vol. 6, No. 3, 209-214, 1983.
University of Duisburg. AUBE '82: 8th International Symposium on Problems of Automatic Fire Detection. October 5-8, 1982, Duisburg, West Germany, 1983.
fire detection systems; environmental effects; economic factors
Three types of intelligence for fire detection systems are discussed. The transision from detector to sensor is an important step and a simple interface in the fire detection system is transferred from the potential fire location to the control unit.

Scheidweiler, A.
Fire Detection Technology Today and Tomorrow.
Cerberus AG, Mannedorf, Switzerland
Fire International, No. 72, 60-64, September 1981.
fire detection systems

Schierau, K.

Schierau, K.
Detection Equipment for Fire Prevention--A Standard Solution?
Preussag AG Minimax, West Germany
New Technology to Reduce Fire Losses and Costs. October 2-3, 1986, Luxembourg, Elsevier Applied Science Publishers, NY, Grayson, S. J. and Smith, D. A., Editors, 256-271 pp, 1986.
fire detection; fire prevention

Schlossarek, U.

Schlossarek, U.
Computergestutzte Automatisierung des Ablaufs technischer Prufungen. [Computer Supported Automation of Technical Tests.]
Duisburg Univ., West Germany
University of Duisburg. International Conference on Automatic Fire Detection 'AUBE '89", 9th. September 26-38, 1989, Duisburg, West Germany, Luck, H., Editor, 733-745 pp, 1989.
In: German
computers

Schungel, H.

Schungel, H.
TEMEX--Ein sicheres Ubertragungsverfahren fur Gefahrenmeldungen?
[TEMEX--A Reliable Transfer System for Warning Messages?]
Verband der Sachversicherer e.V. (Vds), Koln, Deutschland
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '89", 9th. September 26-28, 1989, Duisburg, West Germany, Luck, H., Editor, 505-510 pp, 1989.
In: German
fire detection

Senturia, S. D.

Senturia, S. D.
Chromatographic Analysis of the Response of Polymeric Fire-Detection Devices to Combustion Products. Final Report. May 1, 1975-February 28, 1977.
Massachusetts Inst. of Technology, Cambridge
NASA CR-154845; 23 p. May 1977.
Available from National Technical Information Services N77-30445
fire detection; combustion products; gas chromatography; smoldering
The use of gas chromatography/infrared spectroscopy to correlate the spectrum of combustion products produced by smoldering samples with the electrical response of polymeric early-warning fire detection and to make improvements in device design and performance was studied. The most significant success was in the device ara, in which successful fabrication of charge-flow transistor structures, made possible a realistic, low-cost, miniaturized sensor design. The documentation of polymer responses to a variety of smoldering sources, including cellulose, acrylic, urethane, polyvinyl chloride and wood, was improved.

Siebel, R.

Siebel, R.
Zum Entwurf von Detektionsalgorithmen unter Einbeziehung verschiedenartiger Brandkenngrossen. [Draft of Detection Algorithms of Consideration of Various Fire Characteristics.]
Duisburg Univ., West Germany
University of Duisburg. International Conference on Automatic Fire Detection 'AUBE '89", 9th. September 26-38, 1989, Duisburg, West Germany, Luck, H., Editor, 391-407 pp, 1989.
In: German

Siemund, B.

Siemund, B.
Computertomographische Rekonstruktion von Vektorfeldern.
[Computer Tomographic Reconstruction of Vector Fields.]
Universitat Duisburg, West Germany
Aachener Symposium fur Signaltheorie. ASST '87. 6.
Mehrdimensionale Signale und Bildverarbeitung. September 9-12, 1987, Aachen, West Germany, Springer-Verlag, New York, Meyer-Ebrecht, D., Editor, 323-326 pp, 1987.
In: German
fire detection systems

Skala, G. F.

Skala, G. F.
IFD II--A New Generation Fire Detection System.
Environment/One Corp., Schenectady, NY
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '89", 9th. September 26-28, 1989, Duisburg, West Germany, Luck, H., Editor, 181-197 pp, 1989.
fire detection; fire detection systems; particles; combustion; air sampling; maintenance; reliability

Smith, W. M.

Smith, W. M.
Telephone Connected Early Warning and Communication System.
Totel Systems, Inc., Stratford, CT
National Bureau of Standards (NBS)/National Conference of States on Building Codes and Standards (NCSBCS), Inc.
Research and Innovation in the Building Regulatory Process.
NBS/NCSBCS Joint Conference, 6th. Technical Seminar on Streamlined Administrative Procedures, Computers in Construction, and Fire Safety Technology. September 11, 1984, Denver, CO, NBS SP 694, Beavers, L., Editor, 131-135 pp, 1985.
Available from National Technical Information Services PB85-196541
telephones; warning systems; communication equipment; fire fighting; fire safety; smoke detectors
This paper describes a new development in telephone engineering that provides two vital fire fighting functions--annunciation of smoke detectors by individual

location, and one way voice communication to remote sections of buildings by zone or all-call using existing standard telepone equipment. This development creates an opportunity for advanced fire systems features to be put in place quickly and at low cost since most structures already have complete telephone system wiring and standard station line telephones throughout the building.

Smithiers, J. N.

Smithiers, J. N.; Burry, P. E.; Spearpoint, M. J.
Background Signals From Fire Detectors Measurement--Analysis--Application.
Fire Research Station, Borehamwood, England
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '89", 9th. September 26-28, 1989, Duisburg, West Germany, Luck, H., Editor, 279-295 pp, 1989.
fire detection; fire detectors; signals; analog computer; sensors; optical measuring instruments

Snow, A. W.

Snow, A. W.
Integrated Security Systems.
Fire Prevention, No. 198, 23-25, April 1987.
fire detection systems

Society of Fire Protection Engineers

Society of Fire Protection Engineers
Fire Detection for Robotics Utilizing Fiber Optic Technology.
Society of Fire Protection Engineers. Fire Detection and Suppression...Today's Technology. March 9-11, 1987, Linthicum Heights, MD, 1-7 pp, 1987.
fire detection; robotics; fiber optics; attenuation; decibel levels; glass fibers; fibers
Fiber optic systems offer a new and effective alternative method to transmit electrical information and sense physical events.

Stephenson, M. D.

Stephenson, M. D.
Automatic Fire-Detection Systems.
Electronics and Power, Vol. 31, No. 337, 239-243, March 1985.
fire alarm systems; fire protection; electronic equipment; sensors; smoke; fire detection; false alarms

Suminski, G.

Suminski, G.; Riemer, O.; Hankey, F.
Integrated Fire and Overheat Detection System. Final Report. February 10, 1972-February 10, 1974 and December 16, 1974-June 24, 1976.
McGraw-Edison Co., Manchester, NH
AFAPL-TR-76-64; 321 p. June 1976.
warning systems; fire detectors; aircraft safety; electrical cables
This report describes the background, specifications, design, development, construction and evaluation of an airborne integrated fire and overheat warning system known as the IFOS. It was built to illustrate the possibility of providing fire and overheat detection capability with a high degree of reliability. The IFOS consists of six ultraviolet flame detector heads, two overheatsensing thermistor cables, a central computer unit, a crew readout unit to indicate fire and overheat conditions, a maintenance warning unit to indicate component failure. The system is self-testing to an important degree and completely automatic in operation. Three such systems were constructed and extensively tested. Tests included operation under various conditions of input voltage, temperature and altitude. Response times to fire and overheat conditions were measured, and one system was subjected to vibration, shock, humidity, salt spray and electromagnetic interference tests. In addition, a theoretical study of reliability was made. While the above tests uncovered a number of design weaknesses, all of these defects could be overcome in designing an improved model of the IFOS. It is concluded that a high reliability, automatic fire and overheat detection system is definitely feasible.

Takahashi, N.

Takahashi, N.; Katayama, K.
Alarm Time of Spot Type Rate-of-Rise Detectors Tuned With Ceiling Height and Floor Area Fuzzy Sets.
Japanese Association of Fire Science and Engineering. Fire Research Annual Conference. May 17-18, 1990, 73-74 pp, 1990.
In: Japanese (Abstract in English)
fire research; rate of rise detectors; ceiling height; floors
Simulation of operational time for periphery temperature perpendicular rise in differential spot type detectors which are sensitive to a room's ceiling height and floor space, i.e. fuzzy set. Combined applications of two classes of detectors produce quicker operational time. Discussion on the operation characteristics and design concepts of differential type detectors, which can improve operability.

Takahashi, N.; Katayama, K.
Detectable Fire Size by Using a Spot Type Rate-of-Heat Detector.
Nippon Univ., Japan
Japanese Association of Fire Science and Engineering.
Annual Conference. May 19-20, 1988, Tokyo, Japan, 1-4 pp, 1988.
In: Japanese (Abstract in English)
heat detectors
Using several equations, constants are derived and used to create a detector which operates for perpendicular

periphery temperature rise and combustion directly under the detector and also for combustion positioned away from the detector. Because simulation of operation characteristics is possible for random temperature change, fire-evaluation algorithms can be compared with the differential sensing equipment operation characteristics.

Takahashi, N.; Katayama, K.
Simulation on Work Behavior and Specification for the Spot Type Rate-of-Rise Heat Detector as a Thermal Sensor.
Nippon Univ., Japan
Japanese Association of Fire Science and Engineering.
Annual Conference. May 19-20, 1987, Tokyo, Japan, 129-132 pp, 1987.
In: Japanese (Abstract in English)
heat detectors; simulation; sensors
In fixed-temperature type models, changes emerge between summer and winter operational temperature rise. To improve on this point, and to detect possible sensor adjustments, a differential spot-type detector was used and a simulation of detector operation was conducted. With this model, the adjustment between fire signals given from the detector and fire reports given by applying the algorithm to the sensor output were ascertained.

Takahashi, N.; Katayama, K.; Uechi, F.
Smoothing the Outputs From an Ionization Detector and Identification of Smoldering and Flaming Fires.
Nippon Univ., Tokyo, Japan
Japanese Association of Fire Science and Engineering. Annual Conference. May 22-23, 1984, Tokyo, Japan, 69-72 pp, 1984.
In: Japanese (Abstract in English)
ionization detectors; smoldering
An algorithm is proposed in the case of sampling when an ionization detector sensor output voltage occurs in 6 second cycles. This algorithm has a comparatively longer sampling cycle (30 seconds) which changes from analog voltage to digital voltage. The signal component within the sensor output voltage change is made greater than the noise component.

Takahashi, N.; Katayama, K.; Uechi, F.
Steep and Moderate Rise Rate Model for Outputs From a Fire Detecting Sensor.
Nippon Univ., Japan
Japanese Association of Fire Science and Engineering. Annual Conference. May 20-22, 1986, Tokyo, Japan, 47-50 pp, 1986.
In: Japanese (Abstract in English)
sensors
A D-curve using two types of models, steep and moderate rise-rate, and their expandability was prepared. These models were able to create probable sensor output signal data, excluding the noise component, by calculating several functions, given the parameter values.

Tinkl, W.

Tinkl, W.
Brandkenngrossen analog gemessen und analog ubertragen.
[Measurement and Spread of Large Fires.]
Siemens AG, Munchen
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '89", 9th. September 26-28, 1989, Duisburg, West Germany, Luck, H., Editor, 319-338 pp, 1989.
In: German
fire detection systems

Todd, C.

Todd, C.
Radio Signals to Connect Detectors to Control Equipment.
Fire Surveyor, Vol. 11, No. 5, 37-43, Oct. 1982.
radio waves; fire detectors; fire alarm systems

Todd, C. S.

Todd, C. S.
Detection Systems--State of the Art.
C. S. Todd Associates
University of Edinburgh. Recent Developments in Fire Detection and Suppression Systems. (With Additional Papers From a Course of the Same Title--July 8-9, 1987). November 10-12, 1986, Edinburgh, Scotland, 14 pp, 1987.
fire detection; fire suppression

Tomkewitsch, R.

Tomkewitsch, R.
Brandschutzanlagen mit "verteilter Intelligenz"--Das Pulsmelde-System. [Fire Protection System With "Distributed Intelligence"--The Pulse Notification System.]
Siemens AG, Munchen, West Germany
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '82", 8th. Probleme der automatischen brandentdeckung. October 5-7, 1982, Duisburg, West Germany, Luck, H., Editor, 335-346 pp, 1982.
In: German
fire detection systems

Transue, R. E.

Transue, R. E.
Impact of Modern Electronics on Fire Protection.
Rolf Jensen and Associates Inc., Deerfield, IL
SFPE TR 82-06; 7 p. 1982.
electronics; fire protection

Tussing, J.

Tussing, J.
Pulsed Polling System Sets New Standards in Fire Protection.
Siemens AG, Munich, West Germany
Telecom Report, Vol. 6, No. 4, 155-160, August 1983.
fire protection; fire alarm systems; false alarms; fire fighting
If a fire protection central station can supply specific information on the location of a fire this aids fire fighting operations considerably in that the appropriate extinguishing technique can be employed. The pulse polling system developed by Siemens provides the possibility of furnishing selective and precise information on the location of a fire, and reduces the false alarm rate.

Unoki, J.

Unoki, J.
Fire Protection System--Moving Toward Tomorrow.
5 p. 1990.
In: Japanese (Abstract in English)
fire protection
Possible detection devices of the future are discussed: detectors which could "smell" something burning, a phenomenon which often occurs before a gas appears, composite type fire "smart" sensors using silicon, photoelectric change. In addition, suggestions are made, such as to install detectors after the building is completed/inhabited because the air flow and temperature may differ.

Unoki, J.; Kimura, S.
New Fire Detector for Road Tunnels.
Nohmi Bosai Kogyo Co., Ltd., Tokyo, Japan
Fire Safety Journal, Vol. 6, No. 3, 215-224, 1983.
University of Duisburg. 8th International Conference on Automatic Fire Detection "AUBE '82". Probleme der Automatischen Brandentdeckung. October 5-7, 1982, Duisburg, West Germany, Luck, H., Editor, 134-154 pp, 1983.
fire detectors; flame radiation; tunnels; emergencies

Usuba, T.

Usuba, T.; Nakano, M.; Miyama, J.
Analog Sensors.
Sophia Univ., Tokyo, Japan
Japanese Association of Fire Science and Engineering.
Annual Conference. May 22-23, 1984, Tokyo, Japan, 75-78 pp, 1984.
In: Japanese (Abstract in English)
sensors
Measure temperature detection devices and response speed and investigate thermal equivalent circuits. Create a high air current and measure response time by introducing the temperature detection device into the air current. As wind speed increases, the time constant decreases. As the temperature step width (heat quantity per time unit) increases, the time constant decreases.

Vesin, J. M.

Vesin, J. M.
Modeling of Fire Detector Signals.
Ecole Polytechnique Federale de Lausanne, Switzerland
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '89", 9th. September 26-28, 1989, Duisburg, West Germany, Luck, H., Ed., 305-318 pp, 1989.
fire detection; fire detectors; signals; simulation

Von Tomkewitsch, R.

Von Tomkewitsch, R.
Fire Detector Systems With 'Distributed Intelligence'. The Pulse Polling System.
Siemens AG, Munich, Germany
Fire Safety Journal, Vol. 6, No. 3, 225-231, 1983.
fire detectors; fire alarm systems; smoke detection
This paper discusses the processing of signals from automatic fire detectors. The detectors evaluate the local concentration of the fire characteristics; the author calls this the beginning of "distributed intelligence".

Walker, F. K.

Walker, F. K.; LeCours, C. A.; Radcliff, O.
Fire Alarm System/Fire Suppression System for Mobile Tactical Shelters. Final Report. December 1983-May 1985.
Air Force Engineering and Services Center, Tyndall AFB, FL
AFESC/ESL-TR-85-20; 94 p. August 1985.
Available from National Technical Information Services AD/A-158899
fire alarm systems; fire protection; transportation; fire extinguishing agents; fire detectors; fire suppression; shelters (fallout); fire fighting; storage; manufacturing

Willms, H. I.

Willms, H. I.; Siemund, B.; Lorbeer, G.
Opto-Computer-Tomographical Method for Measuring Smoke Density Distributions.
[Opto-computertomographisches Rauchdichtemessverfahren.]
Duisburg Univ., F.R.G.
Fire Safety Journal, Vol. 6, No. 3, 203-208, 1983.
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '82", 8th. Probleme der Automatischen Brandentdeckung. October 5-7, 1982, Duisburg, West Germany, Luck, H., Editor, 276-294 pp, 1983.
Only the AUBE '82 version is in German.
smoke density; aerosols; computers; simulation

Wilton, R.

Wilton, R.
Recent Technical Developments in the Fire Detection Field.
Fire Engineers Journal, Vol. 47, No. 147, 8-10, March 1987.
fire detection

Yamauchi, Y.

Yamauchi, Y.
Estimation Model for Response Time of a Smoke Detector.
Hochiki Corp., Japan
Japanese Association of Fire Science and Engineering. Annual Conference. May 19-20, 1988, Tokyo, Japan, 9-12 pp, 1988.
In: Japanese (Abstract in English)
smoke detectors
Introduces a model based on the standard "2 layer" model. Using a "zone model" the average temperature and average smoke density in the upper (smoke) layer is measured and an outline of the plume and ceiling jet flow is determined. Next, using a "Boussinesq" approximation, the flow of the plume in the 2nd layer, and temperature, flow, speed, and smoke thickness in the part of the plume hitting the ceiling are determined. Comparisons between experimental calculations and actual data results were exceedingly predictable.

International Fire Detection
Bibliography 1975-1990



Smoke Movement

While there are only a few papers in this section, those here deal with most of the smoke movement issues to be faced by the standards committees, including smoldering fires [Ahola *et al* 1989 and Hotta *et al* 1990], high ceilings [Handa *et al* 1980], high air movement [Meland 1986, Hotta 1990, Hotta *et al* 1990, and Satoh 1990], and stratification [Sargent 1983, Oka *et al* 1990, Hotta and Sugawa 1990, and Sugawa *et al* 1989].

Ahola, H.

Ahola, H.; Kokkala, M.
Experimental Studies on Detection of Smoldering Fires.
Technical Research Center of Finland, Espoo, Finland
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '89", 9th. September 26-28, 1989, Duisburg, West Germany, Luck, H., Editor, 53-73 pp, 1989.
fire detection; smoldering; smoke detectors; fire detectors; air currents; particle size; ventilation; smoke; room burns

Cooper, L. Y.

Cooper, L. Y.
Smoke Movement in Rooms of Fire Involvement and Adjacent Spaces.
National Bureau of Standards, Gaithersburg, MD
Fire Safety Journal, Vol. 7, No. 1, 33-46, 1984.
NBSIR 83-2748; 38 p. July 1983.
Available from National Technical Information Services PB83-250951
combustion products; compartment fires; egress; enclosures; fire detection; fire growth; hazard analysis; mathematical models; room fires; smoke movement; tenability limits
Key to the solution of fire safety design problems is the capability to predict the dynamics of enclosure fire environments. This paper presents a detailed qualitative description of the generic phenomena which occur during typical fire scenarios. The focus of attention is on the effects within building compartments of fire involvement, i.e., compartments made up of a single enclosed space or a space of two or more rooms interconnected by significant penetrations such as open doors or windows. Throughout the discussion reference is made to quantitative methods for predicting some of the most significant of these effects. Reference also is made to available mathematical/computer models which use these latter methods to quantitatively predict the overall fire environment. The basic topics that are covered are: fire growth in combustibles of fire origin; development of the fire plume and interaction of the plume with the ceiling surface; generation of ceiling jet flows which lead to actuation of detection/intervention hardware; interaction of ceiling jets and wall surfaces; growth of the smoke layer; development of wall flows which can be instrumental in drawing smoke down from the upper smoke layer into the relatively uncontaminated, shirking lower ambient environment; downward radiation from the high temperature smoke layer and upper enclosure surfaces which can ultimately lead to flashover; onset of conditions which are untenable for human occupancy or property survivability. Topics related to fire generated environments in multiroom fire/smoke compartments include: dynamics of the smoke and fresh air exchange between the room of fire involvement and the adjacent spaces; dynamics of door/window plumes, ceiling jets, smoke filling and well flows within adjacent spaces; actuation of adjacent space fire detection/intervention hardware; and onset of adjacent space untenability.

DeLuga, G. F.

DeLuga, G. F.
Meeting Control Needs in Smoke Control Systems.
Landis and Gyr Powers Inc., Northbrook, IL
Consulting/Specifying Engineer, Vol. 5, No. 4, 32-39, April 1989.
smoke control; planning; pressurization; stairwells; doors; smoke detectors; ducts

Dillon, M. E.

Dillon, M. E.
Some Reasons Not to Integrate.
Syska and Hennessy, Los Angeles, CA
American Society of Heating Refrigerating and Air Conditoning Engineers Journal, Vol. 27, No. 4, 36-37, April 1985.
smoke detectors; smoke control

Drouin, J. A.

Drouin, J. A.; Cote, A. E.
Smoke and Heat Detector Performance: Field Demonstration Test Results.
Simplex Time Recorder Co., Gardner, MA
National Fire Protection Assoc., Quincy, MA
Fire Journal, Vol. 78, No. 1, 34-38,69, January 1984.
heat detectors; smoke detectors; fire tests

The location of the detectors within each room did not appear to be a significant factor in detector activation times. The ionization smoke detectors operated first in the majority of the flaming-started fires. The photoelectric smoke detectors operated an average of 13.2 seconds after the ionization detectors in the flaming-started fires. The smoke detectors operated before the heat detectors in the majority of the flaming-started fires. The smoke detectors operated an average of 2 1/2 minutes faster than the heat detectors in the flaming-started fires. The photoelectric smoke detector operated first in the smoldering-started fires. The photoelectric smoke detector operated 1 hour, 8 minutes, 29 seconds before the first ionization detector in the smoldering-started fire. In this test, all photoelectric detectors in the room, as well as photoelectric detectors in the corridor beyond the closed door, responded before the first ionization detector. Detectors operated an average of three minutes faster than quick-response sprinklers in the flaming-started fires. The sprinkler and heat detector did not operate in the smoldering-started fire. At the time the first detector operated, the smoke obscuration at the five-foot level was very low. In seven of the eight tests in which sprinklers operated, the detectors provided an additional advance warning, prior to sprinkler operation of between 8 seconds and 13 1/2 minutes. In one test, the sprinkler and first detector operated simultaneously.

Hagglund, B.

Hagglund, B.
Hazardous Conditions in Single Enclosures Subjected to Fire--A Parameter Study.
National Defence Research Inst., Stockholm, Sweden
FOA Report C20524-D6; 25 p. Dec. 1983.
Available from National Technical Information Services N84-24831
enclosures; computer models; room fires; mathematical models; hazard analysis; smoke movement

Handa, T.

Handa, T.; Sugawa, O.; Watanabe, A.
Motion of Fire Products in High Ceiling Enclosure.
Science University of Tokyo, Japan
Fire Research Inst., Mitaka-City, Japan
Conseil International du Batiment (CIB).
Systems Approach to Fire Safety in Buildings. Volume 2. Session 3. Active Systems Performance and Criteria: Smoke Control, Detection, Sprinklers. Session 4. Passive Systems Performance and Criteria: Combustibles, Fire Resistance. August 29-30, 1979, Tsukuba, Japan, III/29-43 pp, 1979.
fire safety; ceilings; enclosures; model fires; time

Heskestad, G.

Heskestad, G.; Hill, J. P.
Experimental Fires in Multiroom/Corridor Enclosures.
Factory Mutual Research Corp., Norwood, MA
NBS-GCR-86-502; 130 p. January 1986.
Available from National Technical Information Services PB86-166105
building fires; burning rate; corridor tests; door leakage; fire measurements; fire research; flashover; flow measurements; smoke detection; smoke movement
A series of 60 fire tests have been conducted in an enclosure consisting of a corridor and three attached rooms, one of which served as a burn room. The purpose was to establish validation data for theoretical fire models of multi-room fire situations with particular emphasis on health care facilities. Fire sources were propylene gas burners, producing steady fires at 56 and 522 kW as well as fires growing with the square of time at several growth rates up to a maximum output of 2 MW. Measurements were made of gas temperatures; ceiling surface temperatures; optical densities in white light and at three discrete wavelengths; concentrations of CO, CO2 and O2; gas velocities; and pressure differentials. In addition, smoke detectors and simulated heat detectors were installed and monitored. In the experiments, various combinations were investigated of fire source, open and closed doors, open or closed window in burn room, and natural or forced ventilation in all rooms. A number of tests were devoted to examining smoke migration via ventilation ducting, and others were designed to examine burning rates of polyurethane slabs installed in the burn room as targets for flashover ignition. The data have been filed with the Center for Fire Research, NBS.

Hotta, H.

Hotta, H.; Oka, Y.; Sugawa, O.
Heat Generation by a Smoldering Fire and Its Effect on the Hot Zone.
4 p. 1990.
In: Japanese (Abstract in English)
heat generation; smoldering
According to tests (as per ISO standards) on the influence of a smoldering fire on the ceiling hot zone and the heat generation of a smoldering fire, if there is a hot zone near the ceiling, or a 2 deg difference between floor and ceiling temperatures, then smoke from a smoldering fire cannot reach the ceiling. The smoke density decreases.

Hotta, H.; Oka, Y.; Sugawa, O.
Interaction Between Hot Layer and Updraft From a Smoldering Fire Source. Part 1. An Experimental Approach.
Nohmi Bosai Kogyo Co. Ltd., Tokyo, Japan
Science Univ. of Tokyo, Japan
Fire Science and Technology, Vol. 7, No. 2, 17-25, 1987.

smoldering; heat generation; smoke detectors; buoyant flow

Hotta, H.; Oka, Y.; Sugawa, O.
Prediction of Thermal Current Flow in an Air Conditioned Zone.
2 p. 1990.
In: Japanese (Abstract in English)
fire detectors
The hot air current within an air conditioned space, normally a 3-D flow, and the up-flow from the fire source are made two dimensional. Using this model, the flow pattern in a clean room was recreated to some extent; however, the physical quantity itself was difficult to plot.

Kasahara, K.

Kasahara, K.; Takemoto, A.
Smoke and Heat Behavior and Fire Detection.
Fire Research Institute, Tokyo, Japan
Japanese Association of Fire Science and Engineering. Annual Conference. May 19-20, 1987, Tokyo, Japan, 121-122 pp, 1987.
In: Japanese (Abstract in English)
smoke; fire detection; fire tests; compartment fires
Based on fire experiments held in a two story, multi-room concrete building, dissipation of smoke and heat differed according to opened and closed doors, windows and other barriers. Smoke density increased and set off smoke detecting alarms if a door of room near the fire source was cracked even slightly. Heat detecting alarms were not triggered if some type of barrier was placed between the fire source and the room containing the alarm.

Ling, W. C. T.

Ling, W. C. T.; Williamson, R. B.
Use of Probabilistic Networks for Analysis of Smoke Spread and the Egress of People in Buildings.
City Polytechnic of Hong Kong
California Univ., Berkeley
International Association for Fire Safety Science. Fire Safety Science. Proceedings. 1st International Symposium.
October 7-11, 1985, Gaithersburg, MD, Hemisphere Publishing Corp., NY, Grant, C. E. and Pagni, P. J., Editors, 953-962 pp, 1986.
egress; fire safety
This paper focuses on the use of a network analysis approach to solve the fire safety problem associated with the spread of smoke and the probability of escape by the occupants before the fire and/or smoke blocks their path. Many random factors affecting smoke production and spread can be accounted for by coupling each smoke spread network to a given fire spread network. Smoke spread is examined for different fire scenarios, and the occupants' egress problem is treated as a dynamic network flow problem for a given fire scenario. The time to detection and to untenable conditions, as calculated from the smoke spread network, determine the time period of the dynamic network under consideration.

Meland, O.

Meland, O.
Influence of the Ventilation System Upon Smoke-Filled
Enclosures and the Detection of Smoke.
SINTEF, Trondheim, Norway
New Technology to Reduce Fire Losses and Costs. October 2-3, 1986, Luxembourg, Elsevier Applied Science Publihsers, NY, Grayson, S. J. and Smith, D. A., Editors, 316-328 pp, 1986.
ventilation; smoke; toxic gases

Oka, Y.

Oka, Y.; Sugawa, O.; Hotta, H.
Penetration Behavior of Weak Buoyant Plumes Into Stratified Hot Zones.
Japanese Association of Fire Science and Engineering. Fire Research Annual Conference. May 17-18, 1990, 53-54 pp, 1990.
In: Japanese (Abstract in English)
fire research; buoyant plumes; penetration
If there is a 2-3 deg C difference between temperature of plume head and peripheral current, the heat plume cannot rise through this zone. If the Richardson coefficient, which expresses the ratio of inertia forces to buoyancy is made, the index penetration behavior of the stable stratified heat zone in the upper area can be predicted.

Sargent, W. S.

Sargent, W. S.
Natural Convection Flows and Associated Heat Transfer Processes in Room Fires.
Californial Insititute of Tech., Pasadena, CA
NBS-GCR-83-447; 525 p. October 1983.
Available from National Technical Information Services PB84-171172
compartment fires; convective flow; doors; heat transfer; room fires; windows
This report presents the results of experimental investigations of natural convection flows and associated heat transfer processes produced by small fires in rooms with a single door or window opening. Calculation procedures have been developed to model the major aspects of these flows. Two distinct sets of experiments were undertaken. First, in a roughly 1/4 scale facility, a slightly dense solution of brine was allowed to flow into a tank of fresh water. The resulting density difference

produced a flow which simulated a very small fire in a room with adiabatic walls. Second, in an approximately 1/2 scale test room, a nearly stoichiometric mixture of air and natural gas was burned at flow level to model moderate strength fires. In this later facility, we directly measured the heat conducted through the walls, in addition to determining the gas temperature and composition throughout the room. The computed results both for the average floor and ceiling zone gas temperatures and for the convective heat transfer in the ceiling jet agreed reasonably well with our experimental data. This agreement suggests that our computational procedures can be applied to answer practical questions, such as whether the convective heat flux from a given fire in a real room would be sufficient to trigger sprinklers or other detection systems in a given amount of time.

Satoh, K.

Satoh, K.
Numerical Study of Interaction Between Buoyant Flow by Fires and Air Conditioning Flow in a Room.
Japanese Association of Fire Science and Engineering. Fire Research Annual Conference. May 17-18, 1990, 55-58 pp, 1990.
In: Japanese (Abstract in English) fire research; buoyant flow; numerical analysis; air conditioning
3-D computer graphics show air flow behavior in an air conditioned room. Fires were started in 5 locations in a room containing a blower and an exhaust vent. In fires positioned near the blower or the exhaust vent, the smoke was diffused or escaped through the exhaust vent and did not reach the ceiling, possibly delaying fire detection.

Sugawa, O.

Sugawa, O.; Kawagoe, K.; Ozaki, K.; Sato, H.; Hasegawa, K.
Full Scale Test of Smoke Leakage From Doors of a Highrise Apartment.
Kajima Inst. of Construction Technology, Tokyo, Japan
KICT No. 58; 14 p. September 1985.
large scale fire tests; fire doors; fire detectors; smoke; smoldering; high rise buildings
This is a check of smoke leakage from an entrance with a class A fire door in a highrise apartment, using a full-scale model. A model fire source was used which was designed to smolder 1 hour and then to flame. Doors opening in and out, with and without air tight material were used. A total of 13 types of experimental conditions were tested, the major variables being whether the door is open or closed, and pressure difference between the fire room and the corridor. The concentrations of smoke, gas, and smoke particles, and also pressures, temperature, and the weight of the fire source were measured. No difference in smoke leakage performance between doors opening in and out was obtained. Smoke and combustion gas in the corridor were hardly detected when the entrance door was closed. This clearly indicates that the central corridor is safe enough as an evacuation route when the door is closed.

Sugawa, O.; Ogahara, I.; Ozaki, K.; Sato, H.; Hasegawa, I.
Full Scale Test of Smoke Leakage From Doors of a Highrise Apartment.
Science Univ. of Tokyo, Chiba, Japan
Mitsui Fudousan Co., Ltd., Tokyo, Japan
Kajima Corp., Tokyo, Japan
Mitsui Construction Co., Ltd., Chiba, Japan
International Association for Fire Safety Science. Fire Safety Science. Proceedings. 1st International Symposium.
Gaithersburg, MD. October 7-11, 1985.
Hemisphere Publishing Corp., NY. Grant, C. E. and Pagni, P. J., Editors. 891-900 pgs. 1986.
and UJNR Panel on Fire Research and Safety. 8th Joint Panel Meeting. Tsukuba, Japan. 927-954 pgs. May 13-21, 1985. 1985.
high rise buildings; large scale fire tests; doors; fire detectors; smoke

van Dijk, H. A. L.

van Dijk, H. A. L.
Movement of Smoke in Buildings on Fire, Calculated by Means of a Dynamic Computer Model, Taking Into Account the Interaction Between Temperatures Throughout the Building and Smoke Spread, Detection and Control Systems.
Institute of Applied Physics TNO-TH, Delft, The Netherlands
16 p. 1980.
smoke spread; building fires; computer models; temperature; smoke control; smoke detection



Standards and Testing

Most of the papers in this section dealing with testing are sufficiently old that their results are well known and integrated into the technology. Of interest, however, is a broad collection of international papers which discuss testing practices and philosophy in other countries; including the European Community [Voigt *et al* 1990], FIRTO (UK) [Phillips 1989] and FOC (UK) [Frost 1983], Egypt [ESIS 1980], Denmark [Laursen 1981], Finland [Ahonen *et al* 1984], India [Sharma 1986], USSR [Romanenkov 1980], CSTB (France) [Mathez 1986], and Japan [Endo 1990].

Ahonen, A. I.

Ahonen, A. I.; Sysio, P. A.
Run-In Test Series of a Smoke Test Room. Tests According to the Proposal prEN 54-9.
Technical Research Center of Finland, Espoo
Research Report 139; 34 p. 1983.
fire detection systems; heat; smoke; aerosol generators; test fires; smoldering fires

Ahonen, A. I.; Sysio, P. A.
Wind Tunnel System for Testing of Smoke Detectors.
Technical Research Centre of Finland, Espoo
Research Report 221; 25 p. September 1983.
smoke detectors; test methods; aerosol generators
A wind tunnel aerosol generator system for testing of smoke detectors according to the European standard proposal prEN 54-7 is described. The system comprises a thermally insulated wind tunnel, a unit for generating and measuring the specified air flow, a heater unit for controlling the air temperature, a pressurized air operated aerosol generator for producing the artificial smoke, and the necessary instruments for the smoke density and temperature measurements. The properties and the stability of the aerosol have been investigated by smoke density measurements using a combination of a standard ionization chamber and two optical densitometers working at different wave length ranges. Excellent long term stability and reproducibility are obtained.

Anderson, N.

Anderson, N.
Testing Smoke Detectors--Could This Be the Answer?
Fire, Vol. 74, No. 912, 39, June 1981.
smoke detectors; tests

Baker, D. R.

Baker, D. R.
Meeting High-Rise Requirements for Fire Detection/Alarm/Suppression.
Skidmore, Owings and Merril, Chicago, IL
Consulting-Specifying Engineer, Vol. 3, No. 2, 56-59, February 1988.
high rise buildings; fire protection; standards; fire detection; fire alarm systems; fire suppression

Baker, D. R.
Performance by Computer Modeling or Prescription by Model Code?
Skidmore, Owings, & Merrill, Chicago, IL
SFPE TR 86-05; 33 p. 1986.
Available from National Technical Information Services
PB88-222062
computers; fire detection; fire alarm systems; smoke detection; fire suppression; computer models
Methods of analysis now allow fire protection engineers to estimate smoke development and sprinkler response time on a personal computer. This report compares existing model code requirements with life safety parameters established by modeling on a PC.

Benarie, M. M.

Benarie, M. M.
Test Fires for the Evaluation of Fire Detectors.
French National Institute of Applied Chemistry Research, Saint-Michel-sur-Orge
Fire International, No. 58, 72-81, December 1977.
fire detectors; fire tests; evaluation

Benjamin/Clarke Associates

Benjamin/Clarke Associates
Operation San Francisco--Smoke/Sprinkler Test. Technical Report.
Benjamin/Clark Assoc., Kensington, MD
101 p. April 1984.
fire detection; fire alarm systems; fire protection; sprinklers; fire tests; room fires

Bright, R. G.

Bright, R. G.
Fire Detection: Legislation, Tests and Findings in the United States of America.
National Bureau of Standards, Gaithersburg, MD
U. K. Home Office Department. Technical Study on Automatic Fire Detection in Non-Domestic Residential Premises. April 4-5, 1978, England, 1-26 pp, 1978.
fire detectors; legislation; tests; fire detection systems

Bright, R. G.
Legislation, Tests and Findings in the United States of America.
National Bureau of Standards, Gaithersburg, MD
Fire Service Technical College. Automatic Fire Detection in Non-Domestic Residential Premises. Technical Study. Paper 6. April 3-5, 1978, Gloucestershire, England, 39-52 pp, 1978.
fire detection systems; legislation; tests

Bright, R. G.
NBS Answers FEMA's Criticisms of the Indiana Dunes Tests of Residential Smoke Detectors.
National Bureau of Standards, Gaithersburg, MD
Fire Journal, Vol. 71, No. 5, 47-49,99, September 1977.
smoke detectors; residential buildings
The March 1977 issue of Fire Journal included an article by Edward Gallagher entitled, "FEMA: NBS Tests Do Not Reflect Reality." The tests referred to were conducted by IIT Research Institute and Underwriters Laboratories, Inc., on contract to the National Bureau of Standards, and the March Journal carried a report on those tests. In the following article, Mr. Bright of NBS analyzes the criticisms of the Fire Equipment Manufacturer's Association and replies to them.

Burry, P.

Burry, P.
Fire Detection Standards: A Case Study.
Fire Research Station, Borehamwood, England
Fire Surveyor, Vol. 16, No. 2, 4-8, April 1987.
University of Edinburgh. Recent Developments in Fire Detection and Suppression Systems. (With Additional Papers From a Course of the Same Title--July 8-9, 1987). November 10-12, 1986, Edinburgh, Scotland, 1987.
fire detection systems; standards

Burry, P.
Fire Detectors in Residential Premises: FRS Tests and Findings.
Fire Research Station, Borehamwood, England
Fire Service Technical College. Automatic Fire Detection in Non-Domestic Residential Premises. Technical Study. Paper 5. April 3-5, 1978, Gloucestershire, England, 33-38 pp, 1978.
fire detectors; residential buildings; fire tests

Cerberus

Cerberus
Fire Tests in a Picture Gallery.
Fire and Security Engineering, Vol. 5, 4-6, August 1989.
fire tests; fire detection
Fire tests were conducted in a large picture gallery at a museum of art with the object of gaining a clear idea of the possibilities of early detection of a developing hazard. The objective was to protect the building and its contents by precise localization and rapid, pinpoint intervention on the basis of a suitable alarm organization.

Cerberus
General Fire Detection System Planning.
Cerberus AG, Mannedorf, Switzerland
Report E 432A; 101 p. 1990.
fire detection systems; planning; installing; fire alarm systems; monitors
The relevant local national planning and installation guidelines or regulations must be obtained and taken into account before starting with the planning of each project. Where no regulations must be taken into account, planning and installation must be carried out according to Cerberus planning guidelines which correspond to the level of performance of Cerberus products. In order to ensure that only approved fire detection products are used, particular attention must be paid to any local regulations concerning product approvals.

Christensen, J. D.

Christensen, J. D.
Experience With Electromagnetic Compatibility (EMC) Testing.
Elektronik Centralen, Hoersholm, Denmark
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '89", 9th. September 26-28, 1989, Duisburg, West Germany, Luck, H., Editor, 715-723 pp, 1989.
fire detection; fire alarm systems; electronic component reliability; electronics; tests; electric potential

Coleman, R. J.

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Operation San Francisco: A Demonstration of State-of-the-Art Sprinkler Technology.
Director of Fire Protection, San Clemente, CA
Fire Chief Magazine, Vol. 27, No. 12, 46-48, December 1983.
sprinklers; fire tests; smoke detectors

Conforti, F.

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Upgraded UL Standards Trigger Smoke Detector Improvements.
BRK Electronics, Aurora, IL
Specifying Engineer, Vol. 47, No. 5, 66-70, May 1982.
smoke detectors; fire protection
UL 268, a new standard for photoelectric and ionization type smoke detectors is discussed. It replaces UL 167 and UL 168 which covered these detectors.

Cooper, L.

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Need for Testing Smoke Detectors.
Oklahoma State University Fire Protection Publications, 1,3, Spring 1987.
smoke detectors

Cooper, L.
Why We Need to Test Smoke Detectors.
Home Safeguard Industries, Malibu, CA
Fire Journal, Vol. 80, No. 6, 43-45, November 1986.
smoke detectors; fire tests

Cowie, G.

Cowie, G.
Test Performance of Automatic Fire Alarm Equipment.
Fire Research Station, Borehamwood, England
FR Note 1063; 8 p. January 1977.
fire alarm systems; fire detectors; tests; fire detection systems; failure analysis

Detriche, P.

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Acoustic Study of Pulsation Characteristics of Fires.
Fire Technology, Vol. 16, No. 3, 204-211, August 1980.
acoustic sensors; combustion stability; fire detection

Drouin, J. A.

Drouin, J. A.
Development of International Standards for Fire Detection and Alarm Systems.
Simplex Time Recorder Co., Gardner, MA
Pacific Rim Conference of Building Officials Proceedings.
April 9-13, 1989, Honolulu, HI, Intl. Conf. of Building Officials, Whittier, CA, 275-280 pp, 1989.
fire alarm systems; international standards org.; standards; regulations

Dubivsky, P. M.

Dubivsky, P. M.
Underwriters Laboratories' Smoke Detector Standards and Tests.
National Bureau of Standards, Gaithersburg, MD
Fire Journal, Vol. 82, No. 1, 45-48,51-53, January/February 1988.
smoke detectors; standards; tests; false alarms

Egyptian Standards Information Service (ESIS)

Egyptian Standards Information Service (ESIS)
Application Test of Fire Detectors.
9 p. 1980.
fire detectors; test methods

Endo, K.

Endo, K.
Evaluation of Standard Fire Tests for Fire Detectors.
2 p. 1990.
In: Japanese (Abstract in English)
fire detectors; fire tests
Using VDS fire testing standards, various types of fire detectors were tested. An evaluation index was determined by using an equation based on the relationship of operational and inoperational characteristics for both fire detection and false alarms. The indexes of similar detectors then were averaged.

Erwin, J.

Erwin, J.
Test Exposure Detector Failures.
Fire Service Today, Vol. 50, No. 4, 14-15, April 1983.
smoke detectors; test fires

Evans, D. D.

Evans, D. D.
Thermal Actuation of Extinguishing Systems.
National Bureau of Standards, Gaithersburg, MD
Combustion Science and Technology, Vol. 40, 79-92, 1984.
NBSIR 83-2807; 28 p. March 1984.
Available from National Technical Information Services PB84-177146
fire models; fire plumes; fire protection; heat detectors; sprinkler systems; zone models
A brief review of the Response Time Index (RTI) method of characterizing the thermal response of commercial sprinklers and heat detectors is presented. Measured ceiling layer flow temperature and velocity histories from a bedroom fire test are used to illustrate the use of RTI in calculating sprinkler operation times. In small enclosure fires, a quiescent warm gas layer confined by the the room walls may accumulate below the ceiling before sprinkler operation. The effects of this warm gas layer on the fire plume and ceiling-jet flows are accounted for by substitution of an equivalent point source fire. Relationships are given for the locating and strength of the substitute source relative to a point source representation of the actual fire. Encouraging agreement was found between measured ceiling-jet temperatures from steady fires in a laboratory scale cylindrical enclosure put into dimensionless form based on parameters of the substitute fire source, and existing empirical correlations from fire tests in large enclosures in which a quiescent warm upper gas layer does not accumulate.

Fire

Fire
Absence of Specific Standards Worries Fire Trades Group.
Fire, Vol. 73, No. 908, 451-452, February 1981.
fire detection; extinguishing; fire prevention; standards

Fire
Barrier Joint Successful in Fire Test at Ronan Point.
Fire Research Station, Borehamwood, England
Fire, Vol. 77, No. 951, 13,17, September 1984.
fire tests; high rise buildings; fire departments
Unwanted fire signals continuously reduce the credibility of automatic fire alarm systems. Any development which provides an improvement on that credibility must be a step in the right direction. Fire brigade delay units of the form described in this article may not be necessary when detection and alarm systems are totally reliable, although even the most advanced "intelligent" system may ultimately include a refined form of delay unit in its control centre.

Fire Surveyor

Fire Surveyor
Fire Detection and Alarm Systems--Introduction to Evaluation and Testing.
Fire Insurers' Research and Testing Organisation
Fire Surveyor, Vol. 10, No. 1, 12-17, February 1981.
fire detection; fire alarm systems; evaluation; tests

Frost, P.

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International Fire Detection Standards: The Present and the Way Ahead.
Fire Offices' Committee, England
Fire Surveyor, Vol. 12, No. 3, 12-16, June 1983.
fire detection; standards; fire alarm systems

Gallagher, E. L.

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FEMA: NBS Tests Do Not Reflect Reality.
Fire Equipment Manufacturers Assoc., Inc.
Fire Journal, Vol. 71, No. 2, 19,38-41, March 1977.
smoke detectors; heat detectors; life safety; tests

Handa, T.

Handa, T.; Fukaya, H.; Sugawa, O.; Kaneko, K.; Hamada, T.; Furukawa, Y.; Endo, K.
Performance Characteristics of Detectors to Fire Products Through Corridors and Compartments.
Science Univ. of Tokyo, Japan
Nohmi Bosai Kogyo Co., Ltd., Tokyo, Japan
Bulletin of Japanese Association of Fire Science and Engineering, Vol. 28, No. 2, 11-18, July 1978.
In: Japanese (Abstract in English)
detectors; large scale fire tests; compartment fires; corridors
The function time and performance pattern of various types of detectors (e.g. ionization smoke detector, rate-of-rise detector, heat detector, gas detector etc.) was pursued individually in full scale corridor and compartment vs. the flow of fire-products evolved from the miscellaneous fire source (i.e. paper, wool, wood and their mixture including some amount of plastics). Each detector worked correctly when the stratification of the fire-products flow was developed. Breaking point was obtained in the output-time curve of each detector corresponding to the time of the successive and itinerant stratification of the flow through the corridor and in the compartment, respectively. These points defined as each detector's correct function-time and were exactly corresponded with the breaking points in the burning

rate-time curves of miscellaneous fire source on reduced time base using time parameter. Following results were obtained: (1) Gas and smoke which were included in the flow head were found to be the ones drifitng around the fire source which had been produced during the very earlier stage of the combustion; (2) The value [equation] and [equation] was individually retained for those in the head and core of the flow of fire-products on real time bases; (3) The gas and smoke detector indicated a quicker response than the heat detector when placed on the same position far from the flaming fire source. However, they worked simultaneously when placed near the flaming fire source; (4) Breaking point-time in the correlation plots of gas output voltage vs. smoke optical density of the two-element detector which were obtained itinerantly through the corridor and in the compartment were found to be coincident with the breaking point-time in the Rb-time curve on reduced time basis, where Rb was the rate of burning; (5) The aforementioned breaking point time was also concident with time when the stratification of the flow was established; (6) Pre-alarm level (optical smoke density, output voltage of gas detector) and alarm level were preferably obtained from the statistical analysis of the working level of the respective detectors with miscelaneous fire source through the corridor and in the compartment. And the alarm-level of the smoke detector was recognized to be identified to the authorized fire-level of smoke-detector in Japan.

Harpe, S. W.

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Challenge for Smoke Detectors: UL's New Smoldering Smoke Test.
Underwriters Labs., Northbrook, IL
SFPE Bulletin, No. 79-4, 1,12-16, September 1979 and Lab Data, 16-22, Spring 1979,
smoke detectors; tests; smoldering

Harpe, S. W.; Christian, W. J.
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Underwriters Labs., Inc., Northbrook, IL
Fire Journal, Vol. 73, No. 3, 48-53, May 1979.
smoke detectors; smoldering; fire tests; death; fire statistics; smoke; furniture; upholstery; residential buildings

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Integration of Fire and Security Systems: Who Will Take the Lead in Standards?
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fire detection; manufacturing

Harris, K.

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Are Municipal Smoke Detector Codes Adequate?
BBK Electronics
Fire Journal, Vol. 75, No. 3, 103,105,144, May 1981.
smoke detectors; fire codes

Harris, K.
Smoke Detector Legislation--An Overview.
BRK Electronics
Fire Chief Magazine, Vol. 25, No. 12, 33-36, December 1981.
smoke detectors; legislation; standards

Heckman, J. H.

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Of Smoke Detectors, Sprinklers, and Building Codes.
Keller and Heckman, Washington, DC
Combustibility Symposium, 12th. April 11-12, 1984, Washington, DC, 1-16 pp, 1984.
combustion toxicity; smoke detectors; sprinkler systems; standards; fire prevention

Hill, R. G.

Hill, R. G.; Johnson, G. R.
Fire Detection, Extinguishment, and Material Tests for an Automated Guideway Transit Vehicle. Final Report. May 1976-August 1976.
Federal Aviation Admin., Atlantic City, NJ
FAA-NA-76-52; 25 p. November 1977.
Available from National Technical Information Services AD-056229
transportation; safety; fire extingushers; fire detectors; management; tests; halon 1301; buses; flammability; photoelectric detectors; ionization detectors

Horiuchi, S.

Horiuchi, S.; Sakai, T.; Tanaka, T.
Fire Growth Model for Small Buildings, report 3. 4 p. 1990.
In: Japanese (Abstract in English)
signals; escape means
Fire testing in a concrete building to gather data necessary for improvements of a formerly developed model which expresses early fire stage before the "flashover" is presented. The combustion speed varied by the type of combustible material. Temperature, static pressure and air currents were influenced by the fire position.

International Standards Organization

International Standards Organization
Components of Automatic Fire Detection Systems. Part 9. Full Scale Fire Test.
International Standards Organization, Switzerland
20 p. 1977.
fire detection systems; large scale fire tests; fire detectors; test fires; measurement

Kahn, M. J.

Kahn, M. J.
Detection Times to Fire-Related Stimuli by Sleeping Subjects.
North Carolina State Univ., Raleigh, NC
NBS-GCR-83-435; 97 p. June 1983.
Available from National Technical Information Services PB83-227116
auditory perception; fire alarm systems; fire detection; human behavior; human performance; odor descrimination; residential buildings; smoke; smoke detectors
A laboratory study was conducted to determine human waking and response times to fire-related stimuli. Twenty-four college-age male subjects were tested with each subject being run for one night. Twelve subjects were exposed to smoke alarm warning signals of three intensities while a second set of twelve subjects was exposed to a smoke odor, a heat presentation, and one smoke alarm warning signal. Subjects were, without fail, awakened by alarms that reached their ears at a signal/noise ratio of 34dB. They were considerably less effective in waking to the heat, the smoke odor, and alarms that reached their ears at a signal/noise ratio of 10dB or less. Failure to detect these latter stimuli may have resulted from a lack of familiarization with the specific fire-related cues used in this research. Had training in detection of these cues been conducted, subjects might have been more responsive. Using similar logic an argument can be made that standardization of signals used for household smoke detectors would be beneficial.

Kaiser, J.

Kaiser, J.; Katzmayr, A.
Testfeuer im Zusammenhang mit automatischen Brandmeldeanlagen. [Test Fires in Connection with Automatic Fire Alarm Installations.]
Zentralstelle fur Brandverhutung, Wien, Osterreich University of Duisburg. International Conference on Automatic Fire Detection "AUBE '82", 8th. Probleme der automatischen brandentdeckung. October 5-7, 1982, Duisburg, West Germany, Luck, H., Editor, 238-258 pp, 1982.
In: German
fire tests; fire detection systems

Kallonen, R.

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Sisustusmateriaalien savunmuodostus. Savukammiomenetelma SFS 4878. [Smoke Production From Interior Finishing and Furnishing Materials. Smoke Box Method SFS 4878]
Technical Research Center of Finland, Espoo
VTT Research Note 449; 29 p. 1985.
In: Finnish
smoke; interior finishes; interior furnishing; textiles; fire tests; fire detection; clothing; standards; regulations; flammability

Kraus, F. J.

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Measuring Techniques for the Response Threshold Value of Smoke Detectors.
Institut fur Electrisch Nachrichtentechnik, Aachen, Germany
National Research Council. Fire Detection for Life Safety.
March 31-April 1, 1975, 63-69 pp, 1975.
fire detection; life safety; smoke detectors; threshold detectors (dosimeters); sensitivity; reliability

Laursen, A.

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Qualification Test of Smoke Detectors.
Danish Research Center for Applied Electronics
Fire Technology, Vol. 16, No. 4, 303-313, November 1980.
smoke detectors; fire tests

Manning, D. O.

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California Residential Fire Detector Tests.
Los Angeles City Fire Dept., CA
SFPE Bulletin, No. 79-4, 1-3, September 1979.
fire detectors; tests; residential buildings

Mathez, J.

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Summary of Workshop No. 2--Tests and Classification.
CSTB, Paris, France
Commission of the European Communities. Fires in Buildings.
September 18-21, 1984., Luxembourg, Elsevier Applied Science Publishers, NY, Mourareau, R. and Thomas, M.,, Editor, 410-414 pp, 1985.
sprinklers; fire detectors; fire detection; fire behavior

Middleton, J. F.

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European and International Standards for Alarm Transmission.
THORN Security Ltd., Feltham, England
University of Duisburg. International Conference on Automatic Fire Detection "AUBE '89", 9th. September 26-28, 1989, Duisburg, West Germany, Luck, H., Editor, 693-701 pp, 1989.
fire detection; transmission; fire alarm systems; signals; standards

Miyama, J.

Miyama, J.
Experimental Research on the Light-Extinction Type Detectors.
Sophia Univ., Tokyo, Japan
Fire Safety Journal, Vol. 6, No. 3, 157-164, 1983.
fire detectors; fire protection; smoke

Mniszewski, K. R.

Mniszewski, K. R.; Waterman, T. E.; Harpe, S. W.; Christian, W. J.
Analysis of Fire Detectors Test Methods/Performance. A Summary Report.
IIT Research Institute, Chicago, IL
IITRI-J6391; FA-14; 419 p. June 1980.
Available from National Technical Information Services PB80-208234
fire detectors; test methods; fire detection systems; fire tests; residential buildings; fire safety; fire protection; warning systems; fire hazards; smoke; building fires; room fires; smoke detectors
This comprehensive report describes the development of existing detector testing and offers limited guidance on installation criteria related to test results. Broad ranges of performance were established and compared reflecting the potential for application of each fire detection unit in a variety of environments. The tests were done in four spaces of different configurations. The testing was done to determine the detectors' effectiveness in terms of life safety. Analysis of the relationship between life safety and property protection clearly indicates that building volume plays a strong role in the life safety aspects of fires. It was found that the criteria for determining detector effectiveness in terms of life safety differ from those directed to determining effectiveness in terms of property protection, the testing of detectors for life safety must also differ. Tests were conducted with flaming and smoldering fires and results have indicated maximum distances or detector placement for all fires in corridors and in large area rooms.

Mniszewski, K. R.; Campbell, J.; Waterman, T. E.; Wakeley, H.
Study of Smoke Detection and Fire Extinguishment for Rail Transit Vehicles. Final Report. November 1981-November 1, 1982.
IIT Research Institute, Chicago, IL
UMTA-MA-06-0153-83-3;
DOT-TSC-UMTA-83-13; 140 p. August 1980.
Available from National Technical Information Services PB84-142652
railroads; smoke detectors; fire safety; fire extinguishers; fire detection systems; fire extinguishing agents; technology assessment; cost effectiveness
This document presents the results of a study to determine the feasibility and cost effectiveness of the use of heat/smoke/fire sensors and automatic extinguishing systems in rail transit vehicles. Work presented includes: a survey of major rail transit systems to determine their fire experience, a survey of available hardware, determination of placement, review of cost effectiveness, and an outline of a testing program to validate conclusions of the study.

Moore, W. D.

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Fire Detection Systems and UL: Some Facts to Replace Fiction.
Massachusetts Fire Alarms, Lowell
Fire Journal, Vol. 72, No. 6, 86-87, November 1978.
fire detection systems; research facilities

Nash, G.

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Development of Special Equipment and Fire-Fighting Techniques.
Fire, Vol. 70, No. 868, 253-256, October 1977.
fire fighting; fire safety; planning; water; fire detection

Northey, J.

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Fire Detection: The New Code and Standards.
Fire Surveyor, Vol. 17, No. 4, 75-78, August 1988.
fire detection; standards; fire alarm systems

Phillips, R.

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Development of Standards and Test Specifications for Fire Detection and Alarm Systems.
Fire Insurers' Research and Testing Organisation, Borehamwood, England

University of Duisburg. 8th International Conference on Automatic Fire Detection "AUBE '82". Probleme der automatischen brandentdeckung. October 5-7, 1982, Duisburg, West Germany, Luck, H., Editor, 555-572 pp, 1982.
fire detection; fire detection systems; fire alarm systems; standards; sensitivity; compatibility; tests

Pickard, R. W.

Pickard, R. W.
History and Development of Standards.
Fire Insurers' Research and Training Organisation, England
Fire Service Technical College. Automatic Fire Detection in Non-Domestic Residential Premises. Technical Study. Paper 4. April 3-5, 1978, Gloucestershire, England, 22-26 pp, 1978.
standards; fire detection systems; installing

Pickard, R. W.
History and Development of Standards for Automatic Fire Detection Equipment.
Fire Insurers Research and Testing Organization, England
Fire, Vol. 71, No. 876, 33-34, June 1978.
fire detection systems; standards; smoke detectors

Pickard, R. W.
Relationahip Between Testing and the Practical Application of Fire Detectors.
Fire Insurers Research and Testing Organisation
Fire Surveyor, Vol. 10, No. 6, 23-26, December 1981.
fire detectors; tests

Pish, M. D.

Pish, M. D.; Munsch, G. F.; Vanzant, W. W.; Edlund, C. E.
Evaluation of Voluntary Standards for Smoke Detectors. Final Report.
Southwest Research Inst., San Antonio, TX
Project 03-5019-001; 483 p. February 1979.
Available from National Technical Information Services PB-295459
smoke detectors; standards

Pistor, M.

Pistor, M.
On a Scattered-Light Measuring Device for the Use in Testing Types of Smoke Detectors. Final Report.
National Bureau of Standards, Gaithersburg, MD
NBSIR 76-1087; 35 p. July 1976.

AACHEN. International Conference on Automatic Fire Detection, 7th. Probleme der automatischen brandentdeckung.
March 5-6, 1975, NBSIR 76-1087, 213-241 pp, 1975.
Available from National Technical Information Services PB-257202
fire detection; light extinction; light scattering; smoke detectors
Generally, the response threshold value of fire detectors is tested with measuring instruments which operate on the same physical principle as the detectors to be tested. For example, this means that the response threshold value of an ionization measuring chamber and the response threshold value of an optical-type smoke detector operating on a light extinction principle is checked using an extinction measuring instrument. However, optical-type smoke detectors operating on a light-scatter principle (photoelectric in U.S. parlance) have also been checked using an extinction measuring measuring instrument. Since the light-scatter type of smoke detector is by far the most commonly used of the optical type of smoke detector it seems appropriate to use a light-scatter measuring instrument to check the response threshold value of these detectors. In addition, the need for such a measuring instrument is emphasized by the fact that both the parameters of the smoke aerosol and the design features of the measuring instrument are affected in different ways by light scatter and light extinction. The author describes the technical features and design details of along with some experiments to determine its response to these detectors.

Poulain, P.

Poulain, P.
Certification Testing of Automatic Fire Detectors and Visual Alarm Systems in France.
Paris R.T.F., No. 154, 22-25, February 1976.
fire detectors; fire alarm systems; certification; tests; ionization detectors

Reiss, M. H.

Reiss, M. H.
Operation San Francisco From the Smoke Detection and Alarm Point of View.
International Fire Chief, Vol. 50, No. 5, 22-24, May 1984.
smoke detection; fire alarm systems; warning systems

Romanenkov, I. G.

Romanenkov, I. G.
Survey of Soviet Scientific Research Projects in the Field of Fire Safety of Buildings and Structures.
National Bureau of Standards, Gaithersburg, MD
NBSIR 80-2103; 39 p. October 1980.

Available from National Technical Information Services
fire detection; fire endurance; fire protection; fire safety; fire suppression; fire tests; flame spread; mathematical models; protective coatings; radiation
This publication is an annotated survey and bibliography by Soviet specialists of 1977-79 Soviet publications on Fire Safety of Buildings and Structures. Some 109 publications are referenced, divided into eight categories: material tests, fire spread on surfaces and field tests, calculating fire endurance, mathematical modeling, fire spread to neighboring structures, automatic suppression and detection, protective coatings, and life safety in fires.

Schnell, M.

Schnell, M.
Points of View in Testing Flame Detectors. Final Report.
National Bureau of Standards, Gaithersburg, MD
NBSIR 76-1040; 18 p. May 1976.
Available from National Technical Information Services PB-254178
fire detectors; flame detectors; heat detectors; smoke detectors; tests; ultraviolet detectors
The general principles for type testing the fire detectors which are already in use in the assessment of heat and smoke detectors are summarized. These include the so-called basic tests and the trial tests. The trial tests were intended to all test fires in order to ensure comparability of tested fire detectors. Additional test fires are proposed which are intended to permit differentiated comparison of flame detectors between one another. The main problem in assessing the performance of flame detectors during environmental influences is the selection of a suitable radiation source for reproducibly simulating the characteristic "flame". The requirements that this radiation source must fulfill are dealt with and various realizations involved are discussed. The practical testing of infrared flame detectors to the basic tests is described. In addition, a suggested test apparatus for ultraviolet flame detectors is dealt with.

Severud, C. N.

Severud, C. N.; Thorpe, R. F.
Analysis of Existing Restrictions on the Installation of Single-Station Smoke and Heat Detectors.
Falcon Safety Products, Inc.
Fire Journal, Vol. 71, No. 5, 41-44, September 1977.
heat detectors; smoke detectors; installation

Shakeshaft, P.

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Review of Data on Active Methods of Fire Protection in Residential Premises: Experimental Fires.
Fire Research Station, Borehamwood, England
CP 21/78; 26 p. January 19788.
residential buildings; fire protection; combustion; living rooms; bedrooms; crib fires; fuel fires

Sharma, T. P.

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Fire Research and Testing Activities in India.
Central Building Research Inst., Roorkee, India
ITSEMAP. International Meeting of Fire Research and Test Centers. Papers. October 7-9, 1986, Avila, Spain, 615-629 pp, 1986.
fire research; fire statistics; fire tests; fire behavior; structures; fire detection; fire extinguishment; explosions; compartment fires; toxic gases; fire retardant treatments

Southern Building

Southern Building
Operation San Francisco Report Concludes Integrity of Exit Paths Can be Ensured.
Southern Building, 53-54, April/May 1984.
sprinkers; smoke detection; exits; fire tests

Thomas, P. H.

Thomas, P. H.
Building Fire Problem: Development of Fire Tests.
Fire Research Station, Borehamwood, England
Fire International, Vol. 5, No. 59, 66-71, March 1978.
building fires; fire tests; building design; education; fire detection; fire control

Thomas, W.

Thomas, W.; Willis, C. L.
National Mandatory Fire Safety Standards.
Consumer Product Safety Comm., Washington, DC
National Bureau of Standards and the American Society for Testing and Materials. Fire Standards and Safety. April 5-6, 1976, Gaithersburg, MD,
American Society for Testing & Materials, PA, ASTM STP 614, Robertson, A. F., Editor, 231-252 p., 1977.
clothing; bedding; burning rate; electric wire; fire detection systems; fire extinguishers; fire hazards; flammability; floor coverings; regulations; heating equipment; television

U. S. Nuclear Regulatory Commission

U. S. Nuclear Regulatory Commission
Fire Protection Guidelines for Nuclear Power Plants.
Regulatory Guide 1.120.
Nuclear Regulatory Commission, Washington, DC
Revision 1; Regulatory Guide 1.120; 29 p. November 1977.
nuclear power plants; fire protection; fire detection; fire suppression; fire departments; safety; fire hazards

Underwriters Laboratories, Inc.

Underwriters Laboratories, Inc.
Smoke Detector Monitors and Accessories for Individual Living Units of Multi-Family Residences and Hotel/Motel Rooms. Standard for Safety.
Underwriters Labs., Northbrook, IL
UL 1730; 49 p. September 24, 1987.
smoke detectors; monitors; multifamily housing; hotels

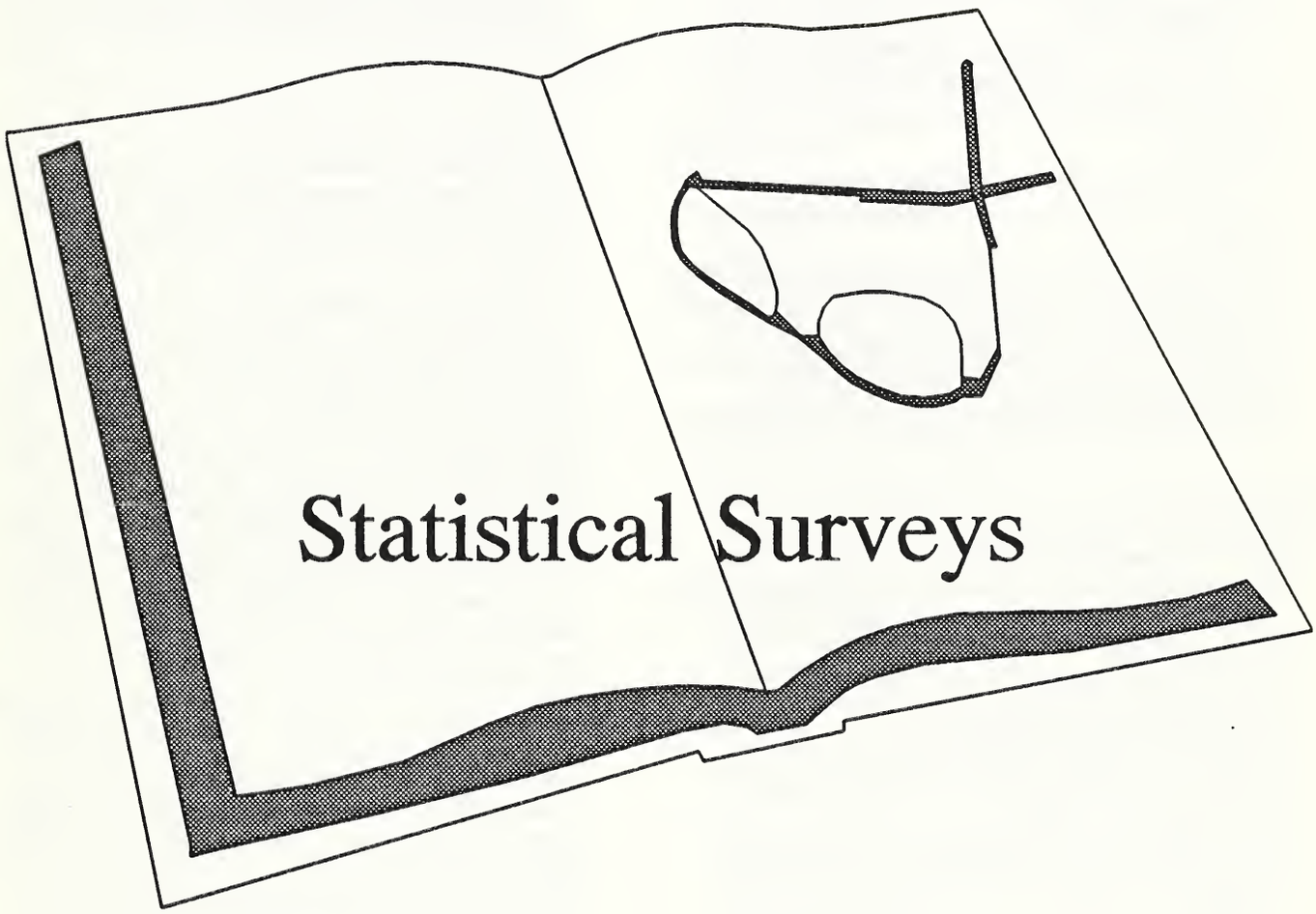
Underwriters Laboratories Inc.
Single and Multiple Station Smoke Detectors. Standard for Safety. Third Edition.
Underwriters Labs., Inc., Northbrook, IL
UL 217; October 8, 1985.
smoke detectors

Underwriters Laboratories Inc.
Smoke Detectors for Fire Protective Signaling Systems.
Standard for Safety. Second Edition.
Underwriters Labs., Inc., Northbrook, IL
UL 268; June 9, 1981.
smoke detectors; fire alarm systems

Underwriters Laboratories Inc.
Smoke Detectors for Fire Protective Signaling Systems.
Standard for Safety.
Underwriters Labs., Inc., Northbrook, IL
UL 268; 79 p. September 21, 1979.
smoke detectors; fire protection; signals

Voigt, H.

Voigt, H.; Avlund, M.
Standardized Smoke Problems Related to Generation of Smoke With Properties as Specified in New European Draft Standards for Automatic Smoke Detectors, prEN54 Part 7 and Part 9.
Danish Research Center for Applied Electronics, Hoersholm
ECR-94; 79 p. June 1980.
Available from National Technical Information Services PB81-100869
smoke; standards; aerosols; exposure; test methods; cigarettes; concentration (composition); smoke detectors; fire detection systems
In recent years, the use of automatic fire detection systems for protection of human lives and property has greatly increased. Since it is of extreme importance that the automatic fire detection systems are reliable and able to operate properly in case of fire, they are subjected to type approvals based on type tests on the subunits in the system. Such approvals are issued by government authorities and insurance companies in a number of countries. At present, great efforts are being made by European Committee for Standardization, Technical Committee 72 (CEN/TC72) to harmonize the requirements and test methods for automatic fire detection equipment among the European countries, in order to encourage the trade between the countries.



Statistical Surveys

On statistics of detector use/performance, John Hall of NFPA is certainly the most prolific, with seven papers in the area. A similar paper on UK experience [Peacock 1990] is included, and the papers by Young *et al* [1990] provide considerable insight into what motivates detector owners. Also appearing in this section is a fascinating survey of unreported (residential) fires [Zdep *et al* 1985] conducted for the Consumer Product Safety Commission (CPSC) which estimates that 95% of all fires go unreported (up from 90% in 1974). Their reason for this is the high percentage of fires discovered early enough by detectors that the occupant can extinguish the fire before significant damage is done.

Association of European Manufacturers of Fire and Intruder Alarm Systems (EURALARM)

Association of European Manufacturers of Fire and Intruder Alarm Systems (EURALARM)
Study of Efficiency of Fire-Detection and Alarm Systems.
Final Document; 12 p. February 1989.
fire detection systems; fire alarm systems; efficiency; fire statistics
The efficiency of fire-detection and alarm systems could be evaluated by different approaches, for example: using data on fires collected either by fire brigades or by insurance companies or using results of inquiries and figures from an Euralarm member. The data given hereafter is non-exhaustive by significative review of such information.

Bryan, J. L.

Bryan, J. L.; DiNenno, P. J.
Examination and Analysis of the Dynamics of the Human Behavior in the Fire Incident at the Avalon Manor
Convalescent Center on June 16, 1978.
Maryland Univ., College Park
NBS-GCR-80-220; 36 p. October 31, 1978.
Available from National Technical Information Services PB80-179054
doors; evacuation; fire departments; fire extinguishers; nursing staff; patients; room fires; smoke; upholstered furniture
The fire incident at the Avalon Manor Convalescent Center on June 16, 1978 was detected by the nursing staff at approximately 1215 hours. At detection, the fire involved an occupied upholstered chair in the second floor T.V. lounge. The two story building of fire resistive construction is approximately five year old. At the time, the facility had a full capacity of 115 patients. The facility emergency procedures were initiated and the volunteer fire department automatically notified with the activation of the local alarm system, through a remote station arrangement to their station response siren. The nursing staff initially evacuated eight patients from the area of origin, and a secondary evacuation of approximately thirty patients from the west wing, second floor to the east wind was accomplished. The fire and smoke were confined to the room of origin by the nursing staff closing of the patient room door and the construction. The fire was extinguished by the facility staff, prior to arrival of the fire department, with a 2 1/2 gallon pressurized water extinguisher and a five pound carbon dioxide extinguisher.

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Examination and Analysis of the Dynamics of the Human Behavior in the Fire Incident at the Ellicott City Middle School on February 14, 1979.
Maryland Univ., College Park
NBS-GCR-80-237; 28 p. March 31, 1979.
Available from National Technical Information Services PB80-207889
evacuation; fire departments; fire investigations; flashover; schools; smoke
This fire incident at the Ellicott City Middle School was detected at approximately 1030 hours on February 14, 1979. The fire was apparently detected in the two-story ordinary construction building, approximately forty years old, by two teachers simultaneously. The detection involved an observation of a light haze of smoke in the second floor learning center with an odor of smoke. An odor of smoke was also detected in the first floor corridor near the cafeteria. Investigation the source of the first floor odor resulted in the observation of a smoke accumulation in the locked and unoccupied band room. Approximately 4 teachers and 120 students, the classes from the first floor cafeteria and the second floor learning center, initiated their evacuation prior to the activation of the local alarm the building in approximately 1-1/2 minutes. With the activation of the local alarm system, the school secretary notified the Howard County Fire and Rescue Emergency Communications Center by phone and the Ellicott City Volunteer Fire Company was dispatched. Due to the extreme cold weather, about 20 deg. F, the principal allowed the students and teachers to reenter the building to the gymnasium on the first floor after five minutes. The Fire Department command officer upon arrival requested the total evacuation of the building again. The fire department completed extinguishment of the fully developed post flashover fire in the first floor band room with 1-1/2 inch hose lines in approximately twenty minutes.

Bukowski, R. W.

Bukowski, R. W.; Istvan, S. M.
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National Bureau of Standards, Gaithersburg, MD
NBSIR 80-2130; 36 p. October 1980.
Available from National Technical Information Services PB81-132276
smoke detectors; false alarms; health care facilities; hospitals; ionization detectors; maintenance; NFPA 101; nursing homes; photoelectric detectors; surveys
A survey of health care facilities in eight states was conducted to gather data on experience with smoke detection systems. Requested information included detector manufacturer and model number, number of detectors and time in service, detector locations, numbers of false and real alarms and the methods and frequency of cleaning and testing the detectors. The results of the survey indicate that about 70 percent of the detectors were ionization type, and 30 percent were of the photoelectric type. Fourteen percent of the total number of detectors were single-station, battery-operated, residential-type detectors, most of which were installed in health care facilities in only one of the eight states surveyed. Almost 80 percent of the detectors were installed in corridors and the average age of the detector installation was about five years. The detection systems were found to experience approximately 14 false alarms for each real fire detected with the highest false alarm rate occurring in detectors installed in laundry areas, storage areas, and kitchens. While over 88 percent of the systems were tested that least annually (55 percent trested monthly), almost half (45.7 percent) were never cleaned. Almost 11 percent of the installed systems were maintained under an outside service contract.

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Prince George's County Fire Dept., Upper Marlboro, MD
Fire Chief, Vol. 25, No. 2, 31-33, February 1981.
smoke detectors; inspection

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Federal Emergency Management Agency, Washington, DC
136 p. 1982.
smoke detectors; fire detectors; surveys

Fire

Fire
US Study Proves That Home Smoke Detectors are Reducing Fire Deaths.
Fire, Vol. 73, No. 907, 407-408, January 1981.
smoke detectors; residential buildings

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National Fire Protection Association, Quincy, MA
73 p. April 1984.
surveys; smoke detectors

Grams, A. C.

Grams, A. C.; Cretser, C. A.
Smoke Detector Human Factor Study. Final Report.
Covina Fire Dept., CA
50 p. September 29, 1978.
Available from National Technical Information Services PB-289860
smoke detectors; human factors engineering; fire alarm systems; residential buildings; surveys; planning; fire safety; education; fire departments
The life saving potential of residential smoke detectors is dependent on correct installation, maintenance and testing, and the practice of an escape plan by household members. Members of the Covina, California Fire Department planned a survey designed to measure the use of and attitude toward smoke detectors in private residences. Interviews were conducted of the same population sample both before and after informational literature was distributed. Results of the study indicate that distribuiton of literature will have but a small impact on developing an awareness towards the maintenance of smoke detectors and escape planning. Special consideration will have to be given the elderly of whom some 30 percent were found to be physically unable to test their detectors. Of greater concern was the finding that only 8.9 percent of the elderly had been involved in an escape plan. It was also found that households in which smoke detectors were required by code were less motivated to test and maintain them than households with owner-purchased detectors. In this same category, however, there was a marked increase in home escape planning and in detector cleaning following the literature distribution. Recommendations are made to communities and to the smoke detector industry on what would improve the effective use of smoke detectors.

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National Fire Protection Association, Quincy, MA
Fire Journal, Vol. 79, No. 5, 37-40, 42-43, 78, September 1985.
fire detectors
One of the most remarkable fire protection success stories of modern times is the widespread adoption of detectors by American households.

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Latest Statistics on US Home Smoke Detectors.
National Fire Protection Assoc., Quincy, MA
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smoke detectors; fire statistics

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Mobile Home Fires in the U. S., 1980-1987.
National Fire Protection Assoc., Quincy, MA
34 p. May 1990.
mobile homes; fire statistics; flame spread; smoke detectors; sensitivity analyses; standards

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Smoke Detector Use on the Rise.
Federal Emergency Management Agency, Washington, DC
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Smoke Detectors Protect Lives.
Fire Admin., Washington, DC
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smoke detectors

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smoke detectors

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Fire Safety Journal, Vol. 14, No. 1&2, 25-32, July 1, 1988.
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fire detectors; home fires
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human behavior; fire safety; building fires; cost benefit analysis; decision; fire losses; smoke detectors; upholstered furniture

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fire detectors; fire detection; combustion physics; false alarms

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Fire Engineers Journal, Vol. 49, No. 154, 31-32, September 1989.
smoke detectors; surveys; public awareness

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smoke detectors; residential buildings; public awareness

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National Fire Prevention and Control Admin., Washington, DC
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smoke detectors; fire detectors; fire safety; fire prevention; fire statistics; surveys

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fire detection systems; reliability; smoke detectors; heat detectors
A survey is made of automatic fire detection systems currently in general use in the U. K. A description of the most widely used detectors is given together with an outline of a typical system. The function of control and indicating equipment is described and the main responsibilities of the user are specified. Some aspects related to systems reliabilty are discussed.

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fire detectors; tests; rate of rise detectors; smoke detectors; photoelectric detectors; ionization chamber detectors

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Survey and Analysis of Occupant-Installable Smoke Detectors. Final Report.
Aerospace Corp., Washington, DC
ATR-77(2819)-2; 503 p. September 1977.
Available from National Technical Information Services PB-284749
smoke detectors; residential buildings; fire detection systems; fire protection; warning systems; surveys; maintenance; installing; manufacturing
Results of the study include: (1) identification of domestic manufacturers of residential smoke detectors, tabulation of the types, features and characteristics of currently available models; (2) estimation of the current (1976) level of detector sales in the conterminous United States, as well as the sales trend for the preceding five years; (3) determination of the level of consumer awareness and acceptance of smoke detectors, the experience of detector owners, the major factors which encourage or deter purchase of smoke detectors, and occupant requirements for residential detectors; (4) comparison of the characteristics of available residential detectors with the occupant requirements for such units, and identification of changes in design and/or merchandising of detectors to achieve a significant increase in their utilization; and (5) recommendation of courses of action to be taken by the NFPCA to aid in achievement of the desired increase in utilization.

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Manufacturer Survey Occupant-Installable Smoke Detectors.
Task Report No. 1.
Aerospace Corp., Washington, DC
ATR-77(2819)-1; 178 p. July 1977.
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smoke detectors; residential buildings; fire detection systems; fire protection; warning systems; surveys; maintenance; manufacturing
The report describes a survey conducted to (1) define the criteria to determine which commercially available smoke detectors are installable by residential occupants; (2) determine and list those manufacturers' models currently available which satisfy the criteria for occupant-installable

units; (3) identify the types, power sources, and features of smoke detectors, by make and model number; (4) determine and summarize the utilization of marketing media by the manufacturers of smoke detectors; (5) evaluate manufacturer's promotional literature and owners manuals; and (6) elicit respondents' comments on current standards, need for a national standard, and the manner in which the NFPCA can assist to encourage the use of smoke detectors.

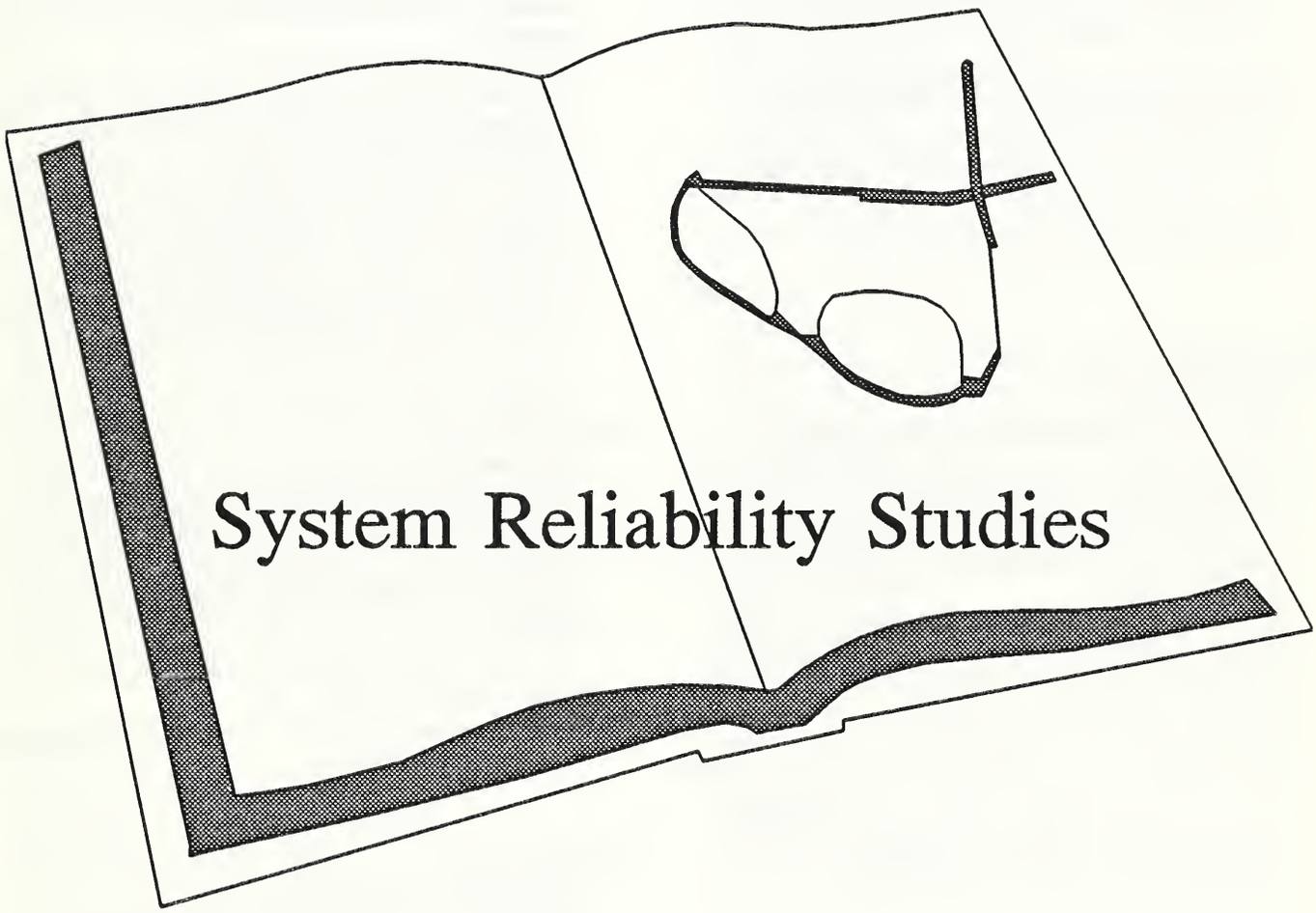
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104 p. June 13, 1985.

building fires; residential buildings

This research was designed to gather data on the extent and nature of unreported, residential fires in the U.S. Data on reported fires are currently gathered annually among a sample of fire departments by the National Fire Protection Association and among states participating in the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS). A systematic attempt to gather data on unreported fires, however, has not been made since 1974. Since widespread use of residential fire/smoke detectors has occurred in recent years, it was considered important to determine if a corresponding increase in the number of unreported fires has also occurred, possibly due to early detection, thereby enabling household members to extinguish residential fires without outside assistance.

International Fire Detection
Bibliography 1975-1990



System Reliability Studies

This being a topic which has generally been understudied, it was pleasantly surprising to see a series of well-done studies from England, Germany, and Norway which were previously unknown in the US. These include Gupta *et al* [1990 and 1985], Peacock *et al* [1990], Rausand [1990], Finucane *et al* [1988], Kamath *et al* [1987], and Unger [1985].

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Development of a Centralized Early Warning Detection System Identifying Explosive Conditions in Grain Handling Facilities.
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dust explosions; warning systems; explosions; computers; fire detection; aerosols; tests; costs

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Fire Alarm and Communication Systems.
National Bureau of Standards, Gaithersburg, MD
NBS TN 964; 49 p. April 1978.
Available from Government Printing Office
fire alarm systems; fire detectors; standards; fire detection; sprinkler systems
The operation and use of all current types of fire alarm and communication systems are discussed. This includes the differences between and operating features of local, auxiliary, remote station, proprietary, and central station systems, high-rise communication systems and residential fire detection devices. A discussion of commonly used fire detectors is given including operation, installation and application considerations. Indicating devices, sprinkler supervisory devices, maintenance, reliability and code/standard compliance also are covered.

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fire protection; life safety; high rise buildings; fire safety

Cerberus

Cerberus
Considerations for the Protection of Road Tunnels.
Fire and Security Engineering, Vol. 5, 6-7, August 1989.
tunnels; fire protection; fire detection; fire tests; fire alarm systems
The following considerations are based on the results of a multitude of fire tests in the laboratory and in the field (road and railway tunnels and installations) as well as on over 20 year's experience gained in planning, building, commissioning and maintaining automatic fire detection system in such tunnels. Approximately 200 road tunnels in Europe and overseas are equipped with Cerberus automatic fire detection systems and more and more traffic by rail is relying on Cerberus protection, too, on engines, carridges, switching posts and stations, etc.

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smoke detectors; room fires; effectiveness; temperature; fire spread; smoke density

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Reliability of Fire Protection and Detection Systems.
United Kingdom Atomic Energy Authority
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fire detection; fire protection; reliability; fire alarm systems; extinguishing

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fire detection systems; fire safety

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fire detection systems; reliability; failure rates; false alarms; chemical plants; hospitals
The malfunctions of automatic fire detection (AFD) equipment are examined on the basis of data collected from various sites in the UK and abroad. A scheme of categorising events into a conveniently small but still comprehensive set of classes is suggested. Failure rates for several sites are derived for various categories of fault. Maximum likelihood and least-squares techniques were employed to estimate Weibull parameters and a summary of this analysis is given. Finally a novel report sheet is presented which forms the basis of a future data collection scheme.

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legislation; fire alarm systems; fire fighting equipment

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Clemson Univ. Annual Southeast Symposium on System Theory, 11th. March 12-13, 1979, New York, NY, 133-140 pp, 1979.
fire alarm systems; reliability; smoke detectors; surveys

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Reliability Assessment of Automatic Fire Detection Systems.
Bradford Univ., England
National Center of Systems Reliability, Warrington, England
Maintenance Management International, Vol. 3, No. 2, 111-131, 1982.
fire detection system; false alarms; fire protection; reliability; data processing
This paper gives an account of a data collection scheme for automatic fire detection system information. The relevant data required for a scheme of this type is described in the form of a data requirement specification. The initial and subsequent response of the data sources is discussed and the major problems encountered in the acquisition of this field data are highlighted. The results of the data collection scheme are given together with a representative sample of collected data for illustrative purposes only. For each of the sites studied, every event is categorized and event rates for the times between events in each category. Specific conclusionsregarding the false alarm rates from various causes are drawn.

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gas detectors; fire detection systems; safety; reliability; arson
The report is part of the documentation from an interdicipline research program aiming at preparing a basis for specification and development of fast action, efficient and highly reliable safety systems for oil and gas process systems. Included in the reliability concept is the minimizaton of the frequency of false alarms. The report presents techniques suitable for anlayzing the reliability of different fire and gas detector systems, both with respect to safety availability and spuriously generated signals. The possibility of common mode failures is included in the calculations.

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NBS-GCR-79-161; 224 p. February 1979.
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component screening; electronic component reliability; failure analysis; failure models; failure rates; reliability; residential buildings
This Residential Smoke Detector Reliability Handbook is designed to provide a means for the accurate prediction of smoke detector failure rates in a residential environment. The methodology developed by which a smoke detector critical failure rate can be determined is divided into three major sections. Section 1.0 contains the parts stress reliability prediction techniques for each major generic component type currently being used in residential smoke detctors, or exhibiting the potential for being in future designs. Section 2.0 through the application of FMECA and/or FTA techniques, presents the guidelines for the determination of those components, and their associated failure modes, which are considered critical to the audible warning capabilities of the detector. The process of applying the predicted failure rates of Section 1.0 to the FMECA/FTA guidelines of Section 2.0 will result in a critical failure rate for residential smoke detectors; i.e., the rate at which failures that will not trigger the audible alarm circuitry may occur, thus negating the protective characteristics of the unit. Finally, Section 3.0 discusses methods of screening for the predominant failure modes of those electronic components characterized as most critical to smoke detector operation, to efficiently detect and eliminate infant mortality failure.

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NBS-GCR-79-162; 100 p. March 1979.
Available from National Technical Information Services PB-295177
component screening; electronic component reliability; failure analysis; failure models; failure rates; reliability; residential buildings; smoke detectors
This Residential Smoke Detector Reliability Handbook is designed to provide a means for the accurate prediction of smoke detector failure rates in a residential environment. The methodology developed by which a smoke detector critical failure rate can be determined is divided into three major sections. Section 1.0 contains the parts stress reliability predication techniques for each major generic component type currently being used in residential smoke detectors, or exhibiting the potential for being in future designs. Section 2.0 through the application of FMECA and/or FTA techniques, presents the guidelines for the determination of those components, and their associated failure modes, which are considered critical to the audible warning capabilities of the detector. The process of applying the predicted failure rates of Section 1.0 to the FMECA/FTA guidelines of Section 2.0 will result in a

critical failure rate for residential smoke detectors; i.e. the rate at which failures that will not trigger the audible alarm circuitry may occur, thus negating the protective characteristics of the unit. Finally, Section 3.0 discusses methods characterized as most critical to smoke detector operation, to efficiently detect and eliminate infant mortaility failure.

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NBS-GCR-79-160; 104 p. November 1978.
Available from National Technical Information Services PB-295176
smoke detectors
The critical nature of the applications of smoke detectors in safeguarding human life and property emphasizes the importance of the reliability of these devices. Smoke detectors, which are relatively inexpensive, must be essentially maintenance free over long periods of time in residential environments, where they may be exposed to a multitude of temperature and humidity conditions or may be laden with dust, grease, insects or other contaminants. Yet, even in these conditions, these devices are required to reliably provide an early warning upon incident of smoke and/or fire. Therefore, it is essential that a reliability prediction methodology most accurately assess the consequences of the design, application and environmental influences upon the ability of the components and circuits employed in smoke detectors to perform their intended functions, even after many years in service.

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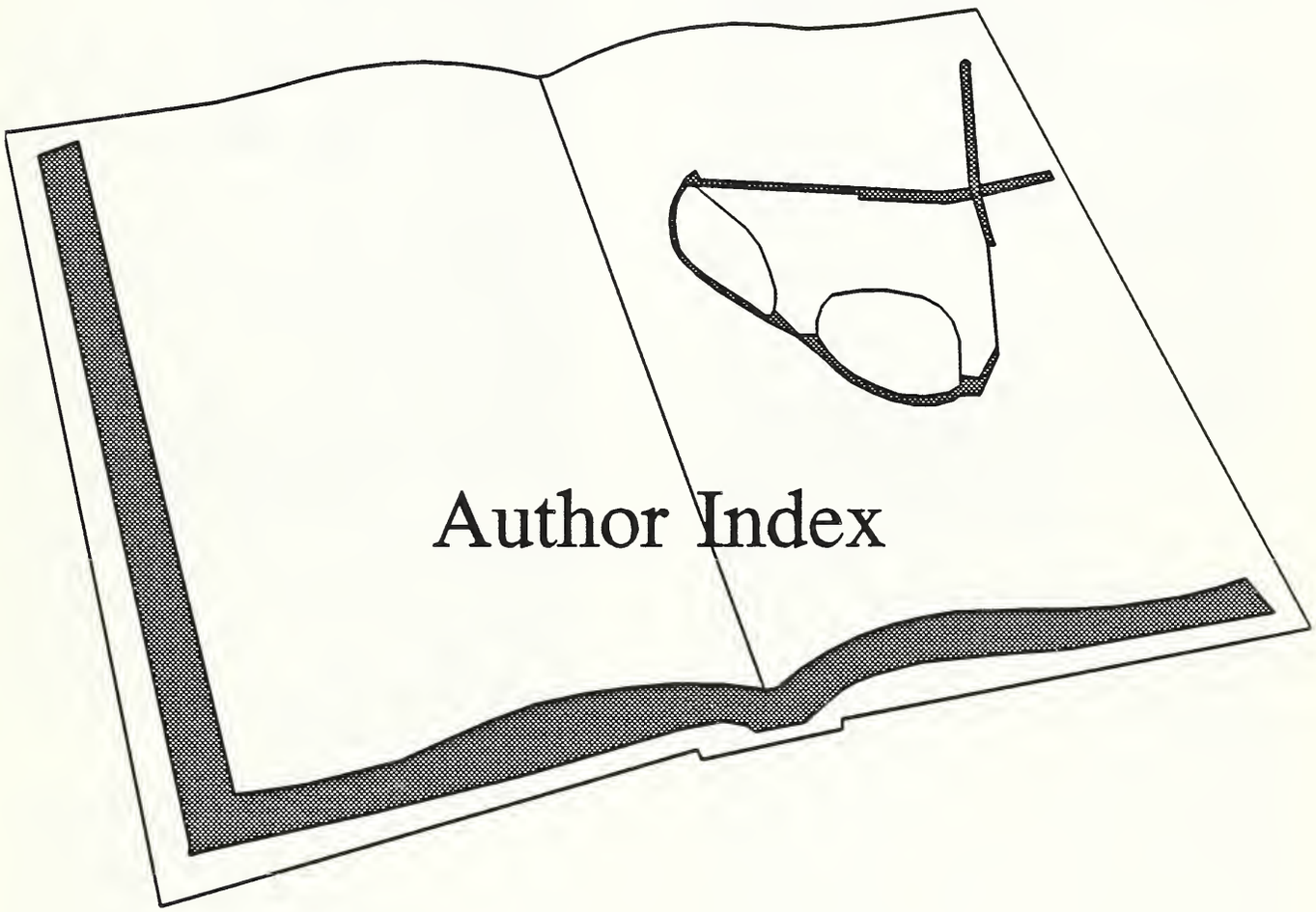
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operations research; electronic component reliability
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Fireline, 6-7, February 1976.
fire detectors; reliability; fire protection
Codes requiring fire protection equipment are becoming more common every day. At present, the biggest growth is in fire alarm systems, sprinkler systems, and communication systems. The laws requiring the installation of such systems, are, of course, very general and, in one way or another, they reference nationally recognized standards for adequacy and reliability. While there are other standards such as ASTM and ANSI, most of us read "nationally recognized standards" as being NFPA, UL, and FM.



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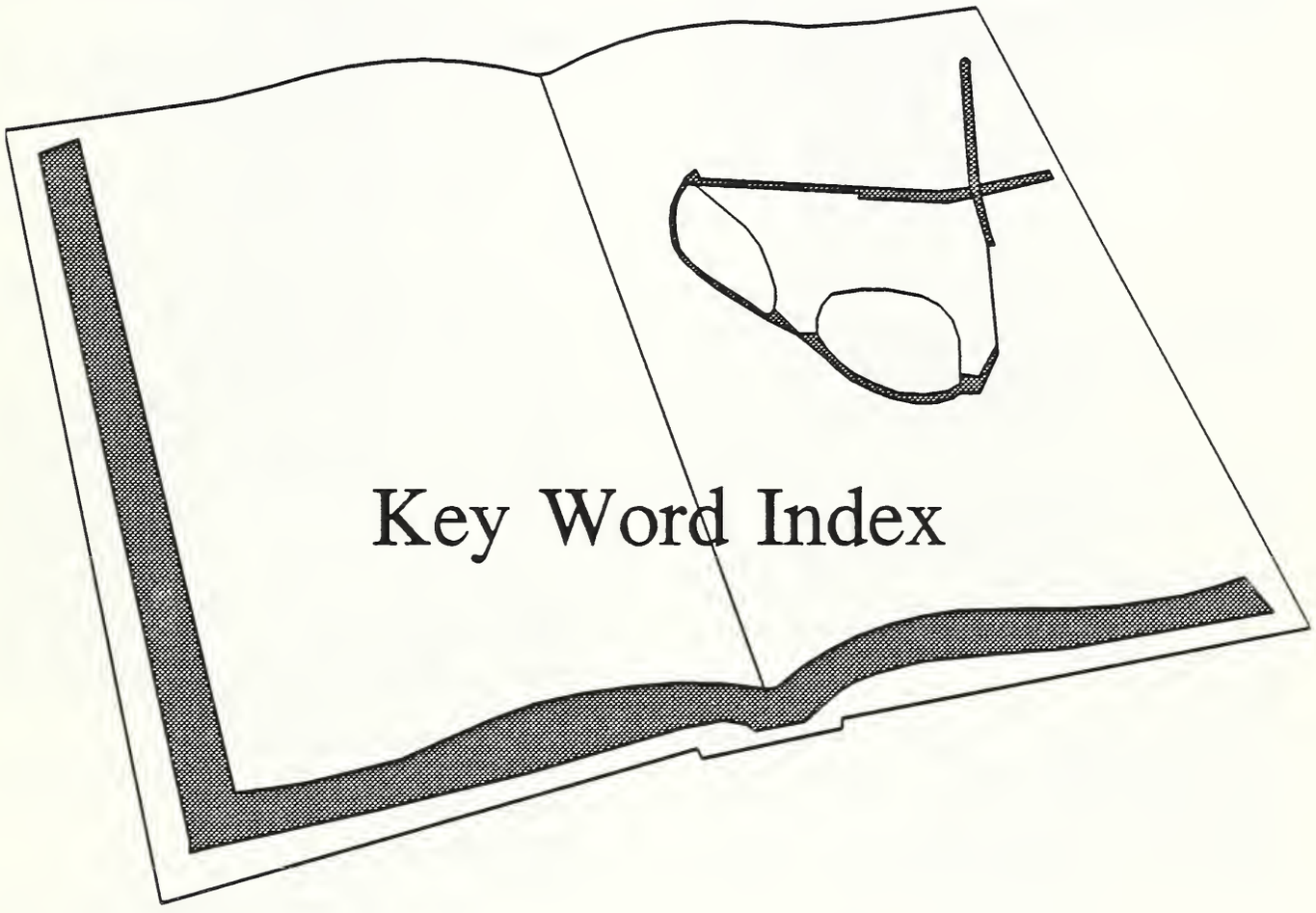
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